

Stone Axe Studies III



Edited by
Vin Davis
Mark Edmonds



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Mark Edmonds



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Vin Davis

Mark Edmonds



Studying stone axes

This volume has been a long time coming. It is the latest in a series which began with the publication of *Stone Axe Studies* in 1979, and continued nine years later with the arrival of a companion entitled, unsurprisingly, *Stone Axe Studies II*. Now, after a rather longer interval, and since it is now a matter of tradition, we arrive at *Stone Axe Studies III*. Finding a title could not have been easier.

The idea for this volume came into focus around three years ago. In the autumn of 2007, we convened a symposium on stone tool studies in the Department of Archaeology at the University of York. This took a broad brush approach, with over seventy papers devoted to research on a wide variety of materials, methods and perspectives. Following publication of those proceedings, we decided that there remained the scope, and the need, for another volume. Here though, the focus would be tighter, restricted to research which dealt directly or indirectly with the stone axe blades that have featured so frequently in our own research.

From the outset, we intended this third volume to be rather different in character to the first and second. With the exception of a minority of papers, both of those volumes were focussed largely on Britain and Ireland. The majority were also concerned with documenting the results of what is now more than 70 years of collaboration between petrologists and archaeologists; research devoted to identifying the raw materials, sources and distributions of stone axes and related non-flint implements. Initiated in South-West England during the early 1940s and taking in most of the British Isles in the decades that followed, this research was for a long time generously supported by the *Council for British Archaeology*, and coordinated by a specialist committee. When these committees were disbanded in the 1990s, the *Implement Petrology Committee* reformed as the *Implement Petrology Group* (IPG). The collaboration continues, but for this volume, we wanted to bring together papers that did rather more than document the results of ongoing petrological characterisation. To begin with, we were keen to widen the geographic focus. Stone axes are a global phenomenon; they occur in prehistoric, historic and contemporary contexts around the world and we felt that this was something that

deserved comparative treatment. Research on these artefacts is also highly diverse, reflecting differences in the character of material and in traditions of academic enquiry. This too was something we wanted to be able to reflect. Beyond everything else, we wanted to find out more about the kinds of approaches being taken, to exchange ideas and information about material traditions in different parts of the world and to learn as much as we could from the process.

As things have turned out, we consider ourselves very fortunate to have been offered so many original and outstanding contributions. The volume brings together scholars working on several continents, all of them connected through their interest in an artefact which, despite a protracted history of study, still has much to tell us. At the outset, it is important to stress that what is offered here is not some singular *party line*. Each contribution takes its own path through material, and uses this to address a variety of concerns. For some, the focus is explicitly methodological; for others, the primary concern rests with arguments about value, the reliability of old data, the significance of new patterns or the most appropriate scales at which work should be set. There are also differences of terminology and interpretation that arise from the very different agendas that characterise research in different parts of the world. In editing this volume, we have tried to avoid the temptation to gloss over these differences of opinion and approach. In fact, we see this diversity as a genuine strength, the juxtaposition of materials and arguments encouraging new approaches and allowing new conclusions to be drawn.

The bulk of the papers document ongoing research on the stone axe in prehistoric Europe, while others present material from as far afield as Australia and India. These sit alongside a number dealing with contexts in which stone axes are, or have been until very recently, an important element in the material repertoires of particular cultural traditions. The material is rich and varied, with papers devoted to all stages in the *life histories* of different materials. Beyond a common commitment to detailed description, many deal with evidence for the procurement and working of stone, the making, hafting and use of blades. Others focus more directly upon the evidence of distributions, or on the changing character of the deposits within which axes have been found. Most, in one way or another, deal directly with the meanings of the stone that people chose to use, with the significance attached to working and

the social significance of blades in use, exchange and deposition. Emphases shift from one paper to another, as do the conclusions that are drawn. Nevertheless, it is still possible to identify a number of common themes.

It is probably simplest to begin with the axe itself, the term used here as a shorthand for blades hafted and used in various ways. As an archaeological category, the axe has occupied an important position in the discipline from the beginning. A building block in the foundation of ideas about prehistory, it has been prominent in the literature ever since, a definitive fossil of particular periods and a touchstone for arguments about the character of human society over time. What almost every chapter in this volume makes clear is that this is nothing new. Whatever the cultural setting, the period or the place, axes have frequently occupied a prominent place in the collective imagination. Moreover, they have generally done so in ways that cut directly across the line that academics often draw between the practical facts of use and the meaningful qualities of material culture. Axes were undoubtedly vital tools, but they were also potent symbols and it serves little purpose to hold these qualities apart.

This complexity has many expressions. Most blades in most areas show signs of use. But there are also examples that would have been impractical for many tasks, either because of their size, fragility or finish. Some are highly elaborate, or polished to a degree which suggests that details of form or colour, even the time given to the task, were sometimes more important than effectiveness. Blades are also the subjects of representation. They appear as elements in complex rock carvings in several parts of Europe and were sometimes emulated in other materials, even reproduced on a massive scale as standing stones. Axes were not the only items to be singled out in this manner. But the fact that they appear so frequently (and so monumentally) makes it clear that they were *artefacts of thought*. In many parts of the world, stone blades were circulated in complex and politically charged networks of exchange. The distances involved are varied in the extreme, but it is clear that the *biography* of a blade – the story of its journey – was often vital to the articulation of ties between people. Those biographies could be further extended where blades were handed down across generations. There is widespread evidence for this, and even for the careful wrapping and curation of individual pieces, forms of treatment that contained the power of blades and sustained their capacity to carry people with them. It is also clear that large



numbers were eventually deposited with a certain formality. Blades occur in ceremonial monuments, in hoards and in burials, and many show signs of having been deliberately broken or burnt. The balance varies from one part of the world to another, but overall, these different lines of evidence suggest that axes, including those which were used, often possessed an importance as *tokens of identity*. Their possession and use, even their movement and treatment, could speak in subtle ways about who people were and the place that they occupied in the world. Put simply, blades mattered. They often stood for something and in some cases may have even been recognised as named and animate entities in their own right.

Of course, what axes meant, if they were recognised as meaning anything at all, was something that varied considerably from one time and place to another. It is also something about which all of us would probably be happy to argue at length. That said, one of the consistent threads in this volume is the idea that the values worked into blades were often implicated in every stage of their life histories. It is perhaps because of this that many of the projects documented here take what we would call a *biographical approach*. Some talk explicitly of *chaines operatoires*, others use different terminologies, but most try to follow the paths that carried blades from their sources through to the circumstances in which they became what we recognise as archaeology. Many also try to look at how the biographies of blades were entangled, not just with people, but also with other materials of practical and symbolic importance; those engaged in hafting or in use, in wrapping and/or deposition. The extent to which this is possible is itself very varied. Research in some regions has a far longer history than in others. Not only that, different academic traditions have tended to favour certain aspects of the data, such as the mapping of distributions, typology or deposition, at the expense of others, making it difficult to identify every stage in those journeys. However, the collective weight of contributions makes a powerful case for such an approach, for an integrated perspective that, at the very least, allies raw material characterisation with the details of technology, typology and context.

The volume also brings broader concerns into sharp relief. Both directly and indirectly, many papers raise questions about methods, their character, application and context. For example, raw material characterisation through petrography or geochemistry lies at the heart of many accounts. The mainstay of work in

Britain, petrography has long been the principal method by which it has been possible to link blades with specific sources and to chart their distributions, often over considerable distances. As such, it has transformed our understanding of the character and complexity of prehistoric societies. However, the addition of dots to maps has often been pursued in relative isolation from the systematic study of other aspects of the evidence, such as the morphology and context of blades. In fact, those of us working in Britain have until recently found ourselves looking both East and West, to projects in Ireland and on the Continent, where research has routinely extended to include details on production, typology and treatment, dimensions which add considerably to interpretation. The situation here is now changing, with new and more integrated studies of a variety of artefacts. However, there are still problems to be tackled. Characterising blades alone, it can often be difficult to differentiate between the use of stone from primary and secondary sources, still less to quantify the contributions that different deposits made to the patterns that we identify. This remains a problem, with the result that it is often difficult to understand patterns of raw material selection against the range of choices that people had available to them. Establishing that background range is certainly crucial. However, this should not be at the expense of work on primary sources themselves, work which has 'taken off' in the last two decades, transforming our understanding in the process. In many cases, the sheer scale and complexity of deposits at primary outcrops is more than enough to justify continued research.

A more pressing issue has been brought into focus with the advent of various geochemical techniques. Providing a high degree of specificity, these methods offer the prospect of high levels of precision. Put simply, they can sometimes make it possible to go beyond linking products with a general source area, to identify the specific formations, workshops and even blocks of material from which particular blades were derived. As several papers demonstrate, there is a potential here to gain insights on the specific choices of material made in the past, and even the biographies of specific artefacts, which may ultimately transform our picture of the processes behind our patterns. As if this was not enough, many of these techniques are also non-destructive, a quality that makes them very attractive to many curators and individuals who retain ownership of blades. While petrography remains an essential part of our tool-kit, the advent and refinement of these new methods



certainly raises questions about the direction of future characterisation research.

The volume also throws up more general questions of scale and interpretation. Many papers document ongoing research on the stone axe in different parts of prehistoric Europe. More often than not, this has tended to be equated with the Neolithic and with farming, the polished blade taken as a *fossile directeur* for the period and for a particular way of life. The link is as old as the discipline, casting the axe in a prominent role as part of a *technology of domestication*, an integral component of the *Neolithic Package*. However, the polished axe as an *artefact of thought* actually has a longer pedigree, in some areas extending a considerable way back into the Mesolithic. It also appears in regions characterised by very different kinds of economies, even circulating between cultural settings that we would recognise as Mesolithic and Neolithic. It is still appropriate to talk of transformations in attitudes towards stone blades as one aspect of the transition between the two periods, even perhaps as a key *idea*. Certainly, in Britain and Ireland, there appears to be a significant shift in attitudes towards stone, quarrying and the making of blades in the centuries around 4000 BC. However, evidence from several regions makes it clear that some of this regard existed long before domesticates made any contribution to people's lives. In other words, the *Neolithic* attitudes that we can trace in attention to stone, and in the making, using and treatment of blades were there from the outset, and grew out of very varied historical conditions. On a continent where the definition and timing of periods changes from one region and from one academic tradition to another, this diversity of historical conditions has a critical importance. It is central to our understanding of the Neolithic and what it meant in different regions, and no less so for our grasp of the different trajectories of development that saw the axe reworked, re-cast or abandoned in the Chalcolithic and Early Bronze Age.

This, in turn, raises questions about the scales at which analysis and interpretation are most effectively set. Some papers deal with patterns that resolve themselves over a few square kilometres; others span more than half the continent, individual blades identified over 1300 kilometres from their geological points of origin. The remarkable scale of these distributions appears to sit comfortably with approaches which emphasise a view of the Neolithic as a pan-European or even global phenomenon. Yet as several contributions demonstrate, that unity

breaks down once we set those distributions in context. Blades were drawn upon differently from one place and time to another, common themes reworked to suit local traditions and specific historical circumstances. Practice varied. Some regions saw a marked emphasis on hoarding, or the routine inclusion of blades in the graves of individuals from an early stage. In others, hoards are less common or more diverse in composition, and grave goods are all but absent. The forms of blades are also sensitive to geography and thus, presumably, to the requirements of specific cultural traditions. They possess an almost bewildering variety and as such, offer a glimpse of the complexity of life, a sense of overlapping *world systems*, *regimes of value* and *local traditions* articulated at many different scales of spatial and temporal resolution. If nothing else, the evidence gathered here catches the tension that exists between *history* and *process*, reminding us that the best work is often that which moves back and forth between the two. And for that to happen, empirical research itself has to be flexible; following the stories of stone from quarry to grave (or midden or field!) and open to the possibility that the significance of particular patterns may only become apparent through a shift of focus.

Another issue that surfaces is the relation with ethnography, particularly the study of societies outside of Western Europe. Spend any time in a museum archive and it is soon clear that from the outset, attempts to make sense of those societies, either on their own terms or as part of crude evolutionary schemes, went hand in hand with collecting and with the search for immediate material parallels between the European past and the Non-Western present. Stone axes were caught up in this process from the start. Born out of European colonialism, such approaches have long been criticised and rightly so. But they have left us with a legacy of materials and concepts which, approached in a different way, still have an important part to play in the development of our understanding. Here, we include a number of papers on contemporary or recent cultural traditions where stone blades were held in a particularly high regard. The material is rich and complex. Each study explores the historically specific meanings worked into stone, establishing what it meant to be involved with objects that often had complex life histories of their own. As such, they are revealing of the often very subtle ways in which making, using and circulating blades contributed to social reproduction.

These are stand alone studies in their own right. Yet their presence in the volume raises



questions about the limits of analogy and the problems and potentials associated with exploring possible archaeological implications. As the contributions here make clear, the ethnographic present does not offer 'off the peg' analogies for archaeologists. What it does offer is a reminder of the kinds of complexity which most likely lie behind our fragments. As such, it is a stimulus to the imagination and a corrective to the dry and simplistic attitudes that still stalk much artefact based research. Not only that, it can even inform the design of research; insights gained in one setting helping us to ask the right questions and more basic still, encouraging us to recognise just how rich our own material actually is. Ethnography demonstrates that technology is, in all times and places, a social phenomenon. In other words, the social is embodied in material tradition, and that is something we are well placed to explore.

Ethnographic collections were just a part of the avalanche of artefacts, including many stone axes, that flowed into European museums in the later 19th and early 20th centuries. Shaped by the biographies of individuals as much as by the agendas of institutions, these collections continue to play a crucial role in contemporary research. However, as many papers here acknowledge, the use of this material is far from straightforward. The history of collections is often so complex that tracking artefacts from one context to another involves dealing with many of the same concerns that we try to address in our work on prehistory. Where and who did artefacts come from? Under what circumstances were they given and once acquired, to what uses were they put? Where are they now? This is often just the beginning, for it is clear that from the later 19th century onwards, antiquarians, archaeologists, excavators and curators were often engaged in forms of communication that were mediated by the flow of things. Acquisition, display, the giving of bequests and the circulation of artefacts all were an integral part of the process through which relations were established and reputations enhanced. There is no small irony in the fact that many early curators participated in various kinds of barter and gift exchange, at the same time arguing that the interpretation of axes was largely a matter of determining their function.

One very understandable response to this complexity would be to turn, as many here have done, to the gathering of new and more reliable datasets. This is, of course, vital, particularly where it allows us to complement existing data (e.g. on distributions) with other material (e.g.

on production, morphology or deposition). But there is much still to be gained from the quarrying of archives. Beyond what they can provide as we ask new questions of the distant past, those archives also tell us something about ourselves; the formation of ideas about deep time, the development of chronologies, the uses of analogy and the social constitution of disciplinary communities. These concerns come into focus in several of the studies presented here which deal with the *afterlife* of axes; the *corridor talk* of what has happened to individual blades since they entered the realm of antiquarian and archaeological interest.

The insights provided by these more historiographic contributions are certainly important. However, it may be unhelpful to assume that the act of discovery and the assignment of new values is something that only happened with the emergence of post-enlightenment perspectives on the past. In fact, there is a wealth of evidence that axes have been collecting people over very protracted sequences. Long before they found themselves in *Cabinets of Curiosities*, blades had caught the eye of classical scholars, who speculated at length about their meteoric or celestial origins, sometimes finding omens in their discovery. They were no less important in the Medieval imagination, gracing collections of marvels amassed and displayed by wealthy merchants, a hallmark of their taste and standing. And all that time, they were also being found in fields; picked up, placed in the rafters or under the threshold, kept close to promote good fortune or to ward off lightning or sickness amongst stock and kin. This again was nothing new. Even in prehistory, blades were sometimes the subjects of a similar fascination, discovered and redefined in both the second and the first millennia BC in many parts of Europe. If nothing else, this tells us that however much we might like to think otherwise, our categories are actually far from fixed. What axes have meant to people, how they were made, used and otherwise drawn upon, has been far from constant. As the papers gathered here demonstrate, we are now beginning to appreciate just how much there is still yet to learn.

In bringing this volume together, we would like to thank all of the contributors for their papers and for their patience. As we had hoped, we have learnt a lot from the process. We would also like to acknowledge the help of Gabriel Cooney, Alison Sheridan, Gavin Ward, Julie Gardiner, Jen Harland and Rosemary Davis for many different kinds of invaluable support. It would not have been possible without them.



Knut Andreas Bergsvik

Einar Østmo



The experienced axe

Chronology, condition and context of TRB-axes in western Norway

Abstract

The early and middle Neolithic populations in western Norway can be characterised as sedentary hunter-fishers practicing agriculture on a small scale. These groups mainly used regionally produced stone adzes, but TRB axes are also found. For the purpose of this paper, these TRB axes have been reclassified and described.

The main bulk of the axes were probably imported during the latter part of the early Neolithic and early part of the middle Neolithic (middle TRB). They were probably made in southern Scandinavia and were distributed to western Norway along the coast from the Oslo fjord.

Most of the axes have been found in the southern part of the region. Although the majority of the axes are complete and typologically certain, many are atypical or had been reworked. Most of the axes have no information on context, but a few seem to have been offered. Contrary to the depositions of the regional adzes, a relatively large portion of the TRB axes were deposited in the inland.

The data together indicates that new ways of perceiving the landscape were linked to these axes, which eventually contributed to a major cultural change towards the end of the middle Neolithic.

Introduction

During the last few years, much interest has been devoted to the interaction between different Neolithic regional groups in Northern Europe. In Norway, relations between groups related to the Funnel Beaker (TRB) culture and the traditional hunter-fisher culture have received particular attention. Agricultural practice, a significant amount of TRB-related artefacts, and some monuments found around the Oslo fjord indicate that people in that area were a part of the TRB culture. Outside of the Oslo fjord; in western Norway and in Middle Norway, people were less affected. In these regions, people continued to live mainly by hunting, gathering and fishing, and their traditional social networks and ideologies seem to have been consolidated and strengthened during the early and middle Neolithic periods. As a result, there were marked cultural differences between these three regions.

Nevertheless, agriculture was practiced to a limited degree in western Norway and possibly in Middle Norway at least from the MNA onwards. Early Neolithic TRB pottery has also been found at some of the sites at the west coast (eg Østmo & Skogstrand 2006). Furthermore, a number of TRB axes have been found in Middle Norway as well as in western Norway (Østmo 1999; 2000). These traits indicate that there were contacts between the TRB-related groups in the Oslo fjord and the hunter-fishers in the west and in the north. In this paper, we shall discuss the character and some of the results of these contacts. Our most important data are the TRB-axes found in the counties Rogaland, Hordaland, Sogn og Fjordane and Sunnmøre (Fig. 1).

Our approach to these axes is “biographical”, influenced by the argument that artefacts, in a way similar to people, should be seen as agents and carriers of information and “experience” (eg Appadurai 1986; Kopytoff 1986, and more recently Glørstad 2008; Gosden 2005; Olsen 2003; Robb 2004). The mapping of aspects related to this “experience” is thus crucial for understanding the social and symbolic significance of material culture (for Neolithic artefacts, see for example Edmonds 1995; Taffinder 1998). In line with this, we argue that the value or significance that people recognized in TRB axes was a consequence of many factors; raw material, shape or utility and also information about origins and history – the “life” of a blade. In our case, distance is a particularly relevant factor. Mary Helms (1993) has convincingly argued that crafted things brought home

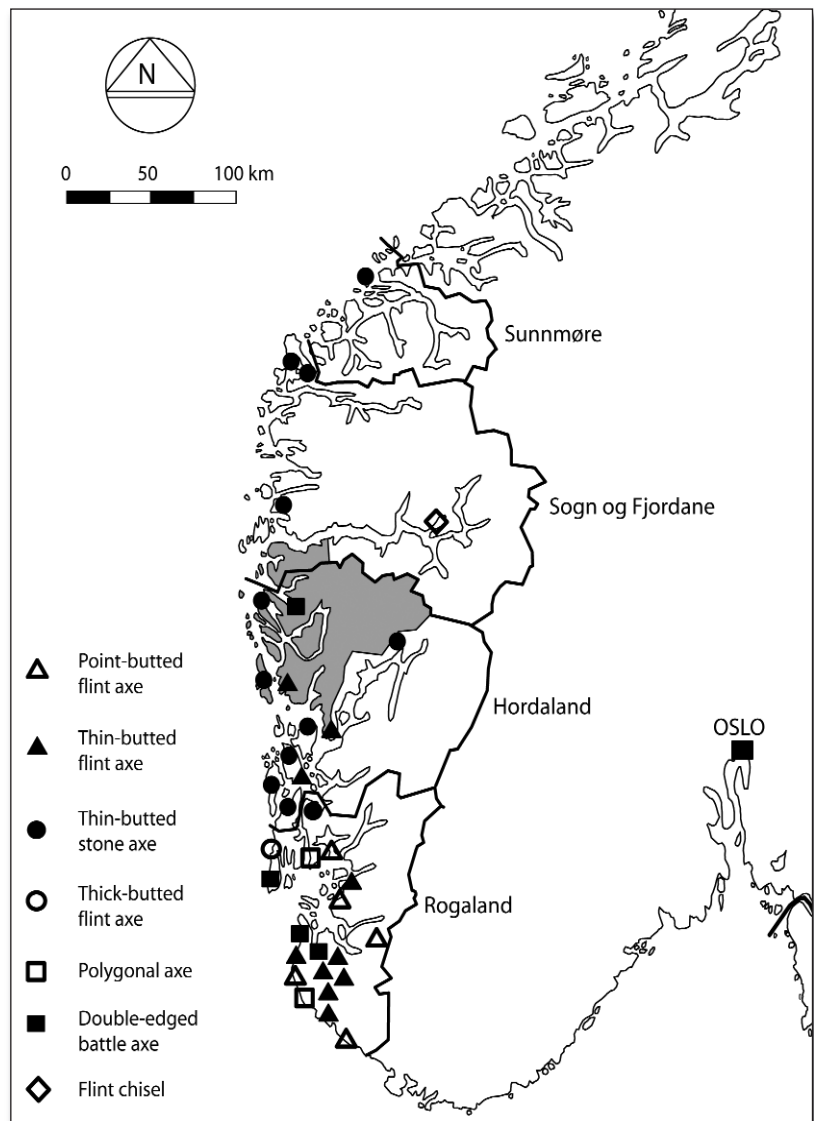


Fig. 1.
The distribution of TRB axes in western Norway.

Shaded area in Hordaland/Sogn is the test-area for the distribution (elevation) of Vespestad adzes and Vestland adzes/chisels.

from far away places tend to be regarded as particularly powerful in traditional societies. But how did this power manifest itself beyond strengthening the social influence of the persons that possessed these things? In this paper we want to explore the nature of the power – or experience – of TRB axes. The main task is to investigate the significance of these axes among local groups in western Norway. Did they – as the material representations of the distant TRB culture – have any impact on the western groups?

The concept of the TRB is here taken in its South Scandinavian sense, and comprises the archaeological material usually considered to belong to the TRB in Denmark and Southern Sweden (as identified in works such as Becker 1948; Blomqvist 1989; Ebbesen 1984; 1994; 1998; Koch 1998; Lagergren-Olsson 2003; Nielsen 1978 and summarised in Jensen 2001). It is the practice of cultivation and husbandry, the presence of TRB-pottery, certain types of



axes and the presence of intentional deposits in the form of graves and offerings that provide the basis for defining an area as part of the TRB culture (Østmo 2007). Populations belonging to the TRB culture were probably interrelated through various kinds of networks, and they probably shared a basic ideology which was related to agriculture, social life, and treatment of the dead. Although these traits may have served as resources for establishing in-group identities as well as out-group categories (Jenkins 1996), the TRB culture as such is not apprehended here as unified socially in the sense that it can be regarded as an ethnic entity.

A detailed chronology based on the TRB inventory of artefacts is applied in South Scandinavia, (eg Becker 1948; 1955; Madsen & Petersen 1984; Nielsen 1985). In Sweden and eastern Norway, however, the chronology is rather more simplified: Early TRB: 5000–4700 BP/3900–3500 cal BC, Middle TRB 4700–4400 BP/3500–3100 cal BC and Late TRB: 4400–4200 BP/3100–2800 cal BC (Østmo 2007). In western Norway the following periods are distinguished: Early Neolithic (EN 5200–4700 BP/4000–3500 cal BC) and Middle Neolithic A (MNA 4700–4100 BP/3500–2600 cal BC) (Nærøy 1993; Olsen 1992). This framework is developed independently of TRB artefacts, on the basis of types common in western Norway, such as stone adzes, projectile points and pottery. It is somewhat different from the (simplified) TRB framework in that the EN in western Norway starts already about 4000 cal BC, that there is no subdivision of the MNA-period, and that it ends later, about 3700 cal BC. Below, we use the chronology of western Norway, but we apply the terms Early, Middle and Late TRB when referring to the axes.

The regional context

The Stone Age of western Norway is relatively well researched as a result of a large number of excavations during the last 30 years. These investigations show that the EN and MN settlements tend to concentrate at the coast. These sites are large and numerous, extremely shore-bound, and are situated close to protected bays, sounds, and channels. Some of the sites have abundant faunal and botanical data, indicating that their inhabitants utilised a broad spectrum of marine as well as terrestrial wild resources. People were probably sedentary, and the area was subdivided by a number of social boundaries (eg Bang-Andersen 1981; Bergsvik 2001; 2002; Hjelle 1992; Kristoffersen & Warren 2001;

Olsen 1992; Olsen & Alsaker 1984; Simpson 1992; Skjølsvold 1977; Solheim 2009). There is broad agreement that the populations were mainly coastal hunter-fishers until the MNB period or, at the latest, until the transition to the late Neolithic period, about 2200 cal BC, and that they were culturally relatively indigenous until then.

That said, some excavations in Western Norway have uncovered traits that somewhat modify the “indigenous” character of these hunter-fisher populations. First of all, several cross-disciplinary studies of settlements and of nearby bogs show that husbandry and cultivation were being practised during the EN in this region. Botanical investigations indicate that forest clearance related to grazing began about 4000 cal BC in Rogaland and possibly also in Hordaland. Pollen of cereals is also present from the early Neolithic at Lista, just south of Rogaland. From about 3500 cal BC, small amounts of cereal pollen as well as directly dated bones of cattle are present. Thus, the palynological data from the EN and MNA indicates that a gradual opening of the landscape – probably related to husbandry – took place during this period, and that small-scale cultivation was introduced in western Norway at least during the transition to the middle Neolithic (summarised in Hjelle et al. 2006; Høgestøl & Prøsch-Danielsen 2006). Secondly, a few shards of TRB pottery were present at some residential sites c.3800 cal BC. Between 3500 and 3300 cal BC, pottery is rather more common at least in the southern part of the area (Hordaland & Rogaland – summarised in Østmo & Skogstrand 2006).

This evidence shows that contacts with TRB populations in eastern Norway were established during the EN, and that these networks expanded during the early MNA. Arguably, TRB type axes are the most tangible representations of the TRB influence in the archaeological record. One may ask whether they were part of a cultural “package” that included TRB pottery, agriculture, and ideas made manifest in practices such as intentional deposition. If so, how influential was this “package” on the local cultural practices of the region? Was it a constant across the region or was it taken on in different ways in different areas? In order to answer these questions it is necessary, in a comparative perspective, to investigate the chronology, the regional distribution, the condition, and the contexts of TRB axes across Western Norway.



Data and methods

TRB-related axes in western Norway have been studied by several scholars. These studies were, however, either performed a long time ago (Brøgger 1907; Gjessing 1945; Gjessing 1920; Hinsch 1955), covered only part of the area (Gjessing 1920), or included only some axe types (Berg 1988). This means that western Norway has lacked an updated and comprehensive study of TRB axes similar to those available for eastern Norway (Amundsen 2000; Mikkelsen 1984; Reitan 2009; Østmo 1988) and middle Norway (Østmo 1999; 2000). For the purpose of this article, the Stone Age collections of the university museums in Stavanger and Bergen were surveyed by the authors, and all identified axes of TRB types found in the area of analysis were reclassified and described on the basis of the relevant typological criteria and chronological frameworks. The following axe-types were identified:

- * *Point-butted flint axes* (Nielsen 1978)
- * *Thin-butted flint axes* (Nielsen 1978)
- * *Thin butted stone axes* (Ebbesen 1984)
- * *Polygonal axes* (Ebbesen 1998)
- * *Thick-butted flint axes* (Becker 1973)
- * *Double-edged battle-axes* (Ebbesen 1975).

Altogether 37 axes, listed in *Table 1*, were identified. *Table 1* also includes more detailed classification and dating of the axes, their size, and comments regarding individual specimens (such as condition and whether the classification is uncertain). In addition, archive information was collected and information from maps was noted on the circumstances of deposition and elevation above the sea level of the place where the axes had been found.

The chronology of axes

The classification of (especially the stone) axes met with some difficulties, due to factors such as fragmentation or reworking. Many in the analysis deviate somewhat from the type description and are consequently listed as atypical. However, it is evident that the thin-butted axe is the most common, there being an almost equal number of flint (12) and stone blades (13) of this type. The other types are only represented by a few specimens each. Chronologically speaking, the identification of types indicates a marked concentration of axes from middle TRB (21), whilst there are fewer from early and late TRB (9 and 7). The majority of the

axes therefore date to between 3500 and 3100 cal BC. Considering that the axes are dated according to south Scandinavian frameworks they may, in theory, have been deposited later in western Norway (Høgestøl & Prösch-Danielsen 2006:23). Ideas about a somewhat “delayed” culture on the northern outskirts of the south Scandinavian Neolithic have been suggested from time to time (e.g. Nummedal & Bjørn 1930:91), but have never been substantiated by empirical observation. This problem is otherwise difficult to evaluate with precision in the present case, as the majority of the axes have not been found in independently dated contexts. Only two are associated with other datable artefacts (S9084 & B12214a), and in these cases, the other artefacts do not contradict the typological dating of the axes. It seems altogether likely that most of the axes have been introduced, used and deposited in western Norway within their general frame of dating. This accords well with the process outlined above, where the evidence for cultivation and husbandry is somewhat more substantial for the MN than for the preceding period. The chronological pattern concurs with the relative quantities of pottery in the two periods. It also concurs with the general development of the TRB culture in Scandinavia, in which middle TRB is clearly the most diversified and rich in terms of material culture expressions, while the late TRB is much less diversified and also more geographically restricted (Browall 1991).

The regional distribution of axes

It may be tempting to assume that all TRB axes in this analysis originated in southern Scandinavia. However, this would be based entirely on details of form and not on more accurate geological investigations and distribution studies. In theory, people in western Norway could have produced TRB axes themselves, based on what they had observed or learnt during contacts with eastern groups. Where this was the case, a locally produced axe – even with a TRB ‘look’ – may have been regarded quite differently to a blade imported from eastern Norway or south Scandinavia. Given this, it is important to consider whether axes were produced locally or whether they arrived as finished blades or blanks, and to explore the routes along which imports traveled into western Norway.

In his discussion of *eastern* Norway, Axel Mjærum has in an unpublished work argued that the majority of the four-sided flint axes

Table 1.
The TRB axes found
in Rogaland (R),
Hordaland (H),
Sogn og Fjordane (SF)
and Sunnmøre (S).



Museum number	County	Axe type		Early TRB	Middle TRB	Late TRB	Typical	Atypical	Reworked	Fragmented	Length m.m.	M.a.s.l.
S1426	R	"Point-butted, thin bladed, two-sided flint axe type 2"	Miniature	X			X				93	375
S2657	R	"Point-butted, thin bladed, two-sided flint axe type 2"		X			X				72	Unknown
S2784	R	"Point-butted, thin bladed, two-sided flint axe type 2"		X			X				73	Unknown
S9019b	R	"Point-butted, thin bladed, two-sided flint axe type 2"	Small	X					X		85	Unknown
S9084	R	Thin-butted flint axe			X		X				155	0 to 10
S8432	R	"Thin-butted flint axe, type III"	Sharp neck		X				X		152	30 – 60
B11026	H	"Thin-butted flint axe, type III"			X		X				176	40
B11261	H	"Thin-butted flint axe, type III"	Edge fragment		X					X	142	7.
S8070a	R	"Thin-butted flint axe, type IV"			X		X				194	100
S2900	R	"Thin-butted flint axe, type III (IV?)"	Edge fragment		X					X	85	Unknown
S4510	R	"Thin-butted flint axe, type V"	Blunt neck			X		X			169	Unknown
S3396	R	"Thin-butted flint axe, type VII"	"Blunt neck, thin specimen"			X		X			126	40 – 90
S3565	R	"Thin-butted flint axe, type VII"	"Blunt neck, sides ground"			X		X			126	40 – 90
B4867	H	Thin-butted flint axe	"Burned, 5 sides ground."	X	X					X		5 to 6
S9391	R	Thin-butted flint axe	Chrush. sides	X	X			X			165	15 – 28
S3341	R	Thin-butted flint axe	Blank	X	X			X			151	60 – 100
S7524	R	"Thin-butted stone axe, type IIC"			X		X				111	5 to 10
B3221	SU	"Thin-butted stone axe, type IIA"	60 mm wide.		X					X		0 – 20
B8304	H	"Thin-butted stone axe, type IIA"	Shelling on one side		X					X	65	0 – 30
B9227	H	"Thin-butted stone axe, type IIA"	Shellings part of original blank?		X				X		162	10 to 15
B9281	SF	"Thin-butted stone axe, type IIA"	"Coarse, sides only min. marked"		X			X			221	Unknown
B9911	SF	"Thin-butted stone axe, type IIA"	Shellings part of original blank?		X		X				233	201
B9977	H	"Thin-butted stone axe, type IIA"	"Concave sides, pecked body, ground edge and neck"		X			X			181	70
B10031	SF	"Thin-butted stone axe, type IA"	Pecked body	X	X					X	115	30
B10694	H	"Thin-butted stone axe, type IA"		X	X					X	76	25
B11643	H	"Thin-butted stone axe, type IIB"			X					X	60	15
B12037	H	"Thin-butted stone axe, type IIA"			X				X		121	10
B12214a	H	"Thin-butted stone axe, type IIB"			X			X			123	15
B13201	R	"Thin-butted stone axe, type IIB"	Edge destroyed		X					X	117	120
S2674	R	"Polygonal axe, type V"	Non-conv edge		X				X		131	Unknown
S5992	R	"Polygonal axe, type II or III"			X					X	101	15 – 25
S8450	R	Thick-butted flint axe. Lindøe type	Only sides are ground			X	X				125	0 – 25
B7668	SF	Flint chisel	Straight edge		X	X	X				140	Unknown
S2645	R	"Double-edged battle-axe, type A1"			X		X				69	Unknown
B3716	R	"Double-edged battle-axe, type A2"	Particularly sharp neck		X		X				231	10 to 20
S1605	R	"Double-edged battle-axe, type C2"	Zig-zag lines on sides			X	X				138	Unknown
B12076	H	"Double-edged battle-axe, type C2"	Coarse form			X			X		123	Unknown



were imported from southern Scandinavia. He took this position because (a), there is a general lack of suitable flint in eastern Norway (the only flint available had been deposited by icebergs towards the end of the late glacial period), and (b), there is a lack of finds of four-sided preforms from the first steps of production (Mjærsum 2004:49). These arguments are also valid for western Norway; there was a general lack of suitable flint on the beaches of the west coast. Furthermore, there are very few indications of use or repair of flint axes at the western sites, and certainly no indications of production. It is therefore likely that the TRB flint axes in western Norway were imported. For stone axes, this is less certain. There were suitable raw materials available in western Norway, such as greenstone and diabase, which were used for the production of regionally specific adzes (Olsen & Alsaker 1984). If the TRB axes were actually manufactured in western Norway, one would perhaps expect that they were made from these raw materials. So far, none of the relevant TRB stone axes has been subject to geological investigation. However, based on hand classification and the authors' experience with western Norwegian rocks, none of the stone axes in this analysis resemble these regionally common raw materials. Furthermore, no preforms for such axes have been found at Neolithic settlement sites or workshop sites in the region. It is consequently likely that most of the TRB stone axes were also imported to western Norway.

Inevitably, some data resist classification on this point. For example, the double-edged battle-axe B12076 has a coarse form which may indicate that it was made by someone who did not really master the craft of making such an axe. This, in turn, might suggest that some of these axes were made locally, but based on "foreign" models. However, these crude forms may possibly also be the results of reworking (see below). These caveats aside, it seems likely that most of the axes in this analysis were in fact imported. Considering the results from eastern Norway, it is perhaps likely that many of them were produced in southern Scandinavia and brought to the west via the Oslo fjord region.

The regional distribution of axe blades exhibits a pronounced concentration in the southern part of the region with a marked fall-off northwards: Rogaland has 21, Hordaland 10, Sogn og Fjordane 4 and Sunnmøre 1. Rogaland also has the greatest variety of types including all of the point-butted flint axes, which are the oldest types included in the analysis. Most of the youngest types; the poly-

onal axes and most of the battle axes, have also been found in Rogaland. Furthermore thin-butted flint axes are much more common than thin-butted stone axes in Rogaland. On the other hand, the latter dominate in the counties north of Rogaland compared to those of flint.

If the regional distribution of the axes is compared to the distribution of TRB pottery and evidence for agriculture, these three traits concentrate in Rogaland and partly in southern Hordaland. Sogn og Fjordane and Møre og Romsdal received very few of these influences. This certainly says something about the direction of the spread of axes, and perhaps of pottery and agriculture as well. If we assume that a direct contact between southern Norway and Jutland is unlikely during these periods (cf Østmo 2005), then flint axes would have been transported via the Oslo fjord region. From there to western Norway, there are three possible routes:

- 1: Along the southern coast and northwards,
- 2: Across the mountains separating eastern and western Norway, and
- 3: To Trøndelag along the eastern valleys and southwards along the coast.

Of these alternatives, route 3 is not very likely. The number of TRB axes in Trøndelag is quite low (Østmo 1999), and it is unlikely that many blades could have been distributed further south from there. Secondly, the number of axes in the northern part of the study area is very small, indicating a very low supply. Route 2 is the shortest towards the west coast as the crow flies, but is not very likely either. Contact networks across the mountains seem to have been poorly developed; the eastern populations frequently used the mountain plateaus for hunting and fishing, but these areas were visited only to a limited degree by the western groups, who lived mainly on the west coast (Bergsvik 2006:134; Indrelid 1994:302). Route 1, however, is strongly supported by the data.

The patterns described above indicate that TRB axes came from the Oslo fjord along the southern coastline. As a result of this, TRB influence was relatively strong in the southern part of the region, and there is marked fall-off between the southern and the northern part of Hordaland. Distance from the source is an obvious reason for this marked change in the relative distribution of axes. But there may also be other causes. During the last few years, several studies have indicated that the coast of western Norway was subdivided by a number of social (ethnic) boundaries. One such boundary is



identified just to the south of Rogaland, another to the north of that county. Five more boundaries are identified further north along the coast (Bergsvik 2006; Solheim 2009). These boundaries, which had roots in the preceeding period (Bergsvik & Olsen 2003; Olsen & Alsaker 1984; Skjelstad 2003), effectively hindered large-scale communication, but allowed for some 'trespass' related to barter or various types of exchanges (Bergsvik 2009a). Apparently, the boundary to the south of Rogaland allowed a number of TRB axes through the social networks, but it is possible that the boundaries further north "filtered out" a further flow into the northern districts.

There is a marked regional difference in the raw materials from which thin-butted axe blades were made. Flint axes dominate in Rogaland, whereas in Hordaland most are made of stone. This is puzzling, as it goes against the observation made by Gutorm Gjessing (1945:352) concerning southeast Norway, that TRB flint axes are more widely distributed than those of stone. He took this as a sign that the flint axes had been more attractive and 'sought after' outside the area of settlement of the TRB culture. The distribution in western Norway might rather invite the conclusion that flint axes to a greater extent remained in the regions closer to their origin, and that the hunter-fishers further north preferred axes that were made of stone.

The condition of axes

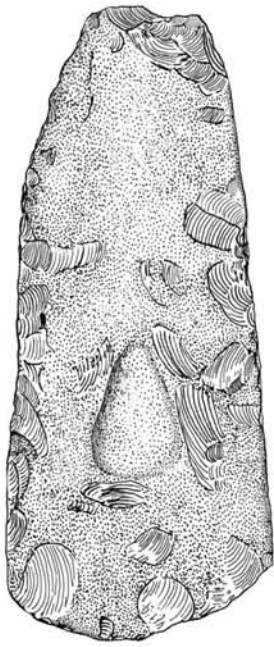
Most TRB axes in western Norway were probably imported from southern Scandinavia, but what did they look like after such a long journey, and how did the foreign shapes and forms affect conditions in the west? As to condition, four main groups can be distinguished among the axes (*Table 1*): group 1: typologically certain and complete (typical) (13 axes), group 2: typologically uncertain (atypical) (7 axes), group 3: reworked (6 axes), and group 4: fragmented (11 axes). (*Fig. 2*)

The axes belonging to group 1 were probably used only to a limited degree and may instead have been regarded as valuables to be displayed, gift-exchanged, and eventually offered/deposited. Their influence may thus have been ideological and social more than practical. At least three from group 1 have almost certainly been offered (see below). Concerning this group, it is worth noting that none of the exceptionally long thin-butted flint axes found at offering sites in Denmark, Sweden and eastern Norway are present in our data (Sundström

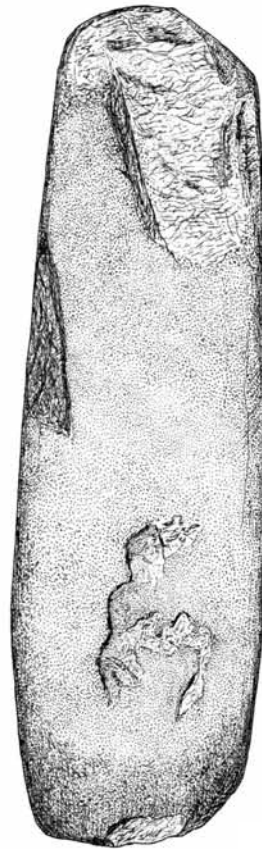
2003:154; Østmo 2007). With regard to group 2, these may, as pointed out above, have been produced in western Norway. However, an equally likely option is that their transformed shapes are the result of long periods of use and frequent changing of hands. This option is also likely for group 3, which display clear indications of reworking. It is impossible to say whether modification or reworking happened among the western groups or if axes already had these attributes when they entered western Norway. The 7 fragmented axes, on the other hand, were certainly destroyed after they had arrived, possibly during work, alternatively as deliberate destruction. This brief description shows that as much as 24 out of 37 axes were typologically insecure, reworked, or broken. This indicates that most of the axes were used as working tools after they came to western Norway. With regard to "experience" this is very illuminating, because it implies that, even if they originally may have been acquired as gifts or valuables through barter or exchange networks, most of them still went into spheres of daily life and activity. Their new owners in the west may, of course, have applied them without reflecting much upon their previous life histories. But it is perhaps more likely that they were aware of such qualities. If so, the axes might perhaps then influence and in some ways change the activities in which they were engaged – by virtue of originating in distant places, where things were done differently.

One such influence might be on the local production of adzes. This has recently been suggested by Fredrik Hallgren, who argues that the Vespestad adze is a variant of the four-sided axes of the TRB culture (Hallgren 2008:248). While this is an interesting idea, it remains problematic. Although most TRB axes and Vespestad adzes are four-sided, there are several other features that distinguish them. First of all, the Vespestad/Vestland adzes are adzes – not axes (*Fig. 3*). They were hafted differently and were probably used for quite different purposes. Adzes are mainly used for scooping out, whereas axes (at least the ones without shaft-holes) were mainly designed for felling trees. Second, the Vespestad adze was introduced in western Norway by c. 4000 cal BC, which is earlier than the appearance of four-sided axes in South Scandinavia. Third, the Vespestad/Vestland adzes are all made from regionally available raw materials (quarried outcrops), many of which were also used to make earlier, Mesolithic, adzes (Olsen & Alsaker 1984). In our view then, Vespestad adze production was a regionally specific tradition with deep roots and quite independent of the TRB.

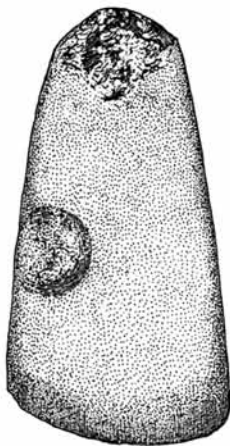




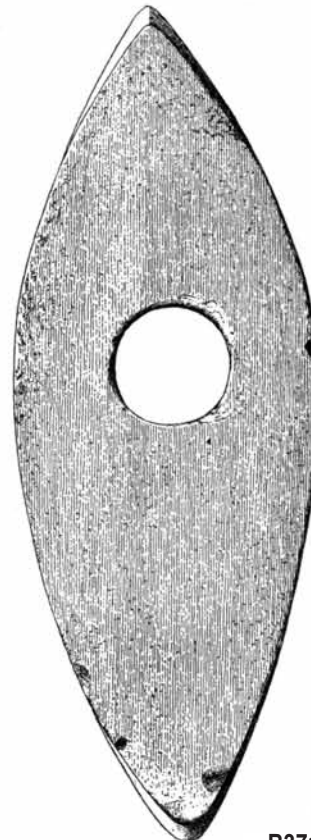
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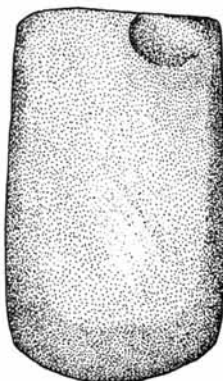
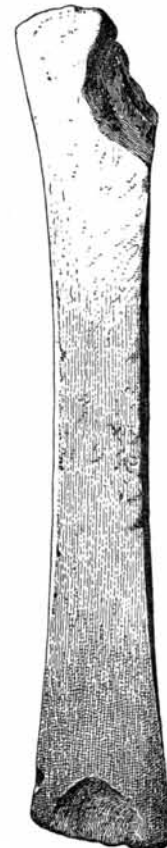
B9911



B12037



B3716



B8304



Fig. 2.
Examples of typical
(B11026, B9911,
and B3716),
reworked (B12037) and
fragmented (B8304)
TRB axes.

B3716 is reproduced
from Brogger 1907, 74).
The remaining axes are
drawn by Ellinor Hoff.

What of the idea that TRB axes were used in different ways to their locally produced counterparts? Regionally specific adzes were probably used for activities such as the scooping out or hollowing of timbers and would thus have been important in the making of dugout canoes. Although no such canoes have yet been found in western Norway, site locations as well as the general marine diet of populations show that they were completely dependent upon boats in their daily lives. Suitable trees for making dugouts were also readily available. There may, therefore, have been a strong relation between Vespestad/Vestland adzes, canoes, and the marine environment. Although TRB axes could have also been used for making dugouts, this was probably not their main function. Experiments with thin-butted axes show that they were very well suited for felling trees (Jørgensen 1985), an inland activity related to the opening up of country for dwelling and cultivation. In effect then, TRB and Vespestad/Vestland blades had associations with different tasks and with different parts of the landscape.

The contexts of axes

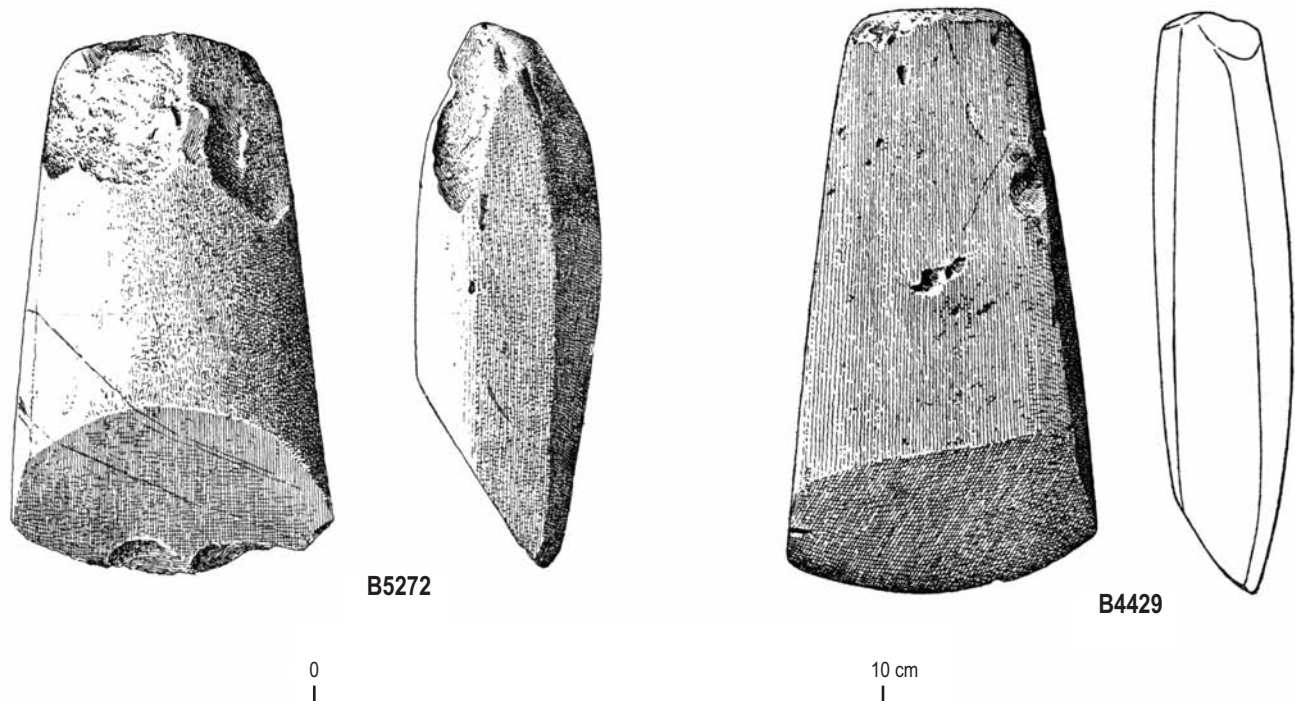
Fig. 3.
Examples of a Vespestad
adze (B5272) and a
Vestland adze (B4429).

Reproduced from
Brogger 1907, 29, 39).

In *eastern* Norway, many TRB axes have come to light as stray finds. However, several have also been found in graves and as offered deposits, and complete as well as fragmented axes have been found at settlement sites (summarised by Østmo 2008:78 ff). In western

Norway, the deposition of Vespestad/Vestland adzes is also relatively varied; examples occurring in offered deposits and in large quantities at settlement sites. This indicates that the most common axes/adzes in both regions had dual functions as both working tools and as features in certain kinds of ritual.

Against this background, the picture for TRB blades in western Norway is far from clear, largely due to a lack of contextual evidence. A few axes probably stem from settlements (S9084, B11261 and B12214a), considering that they have been found together with other artifacts. Some of the fragmented specimens in the analysis (B11261, S2900, B8304, B10031, B10694, B11643 and S5992) may also be from settlements, where they were discarded or used as raw materials for other types of tools. There are, however, arguments against this interpretation. First of all, no complete or even fragmented TRB axe has yet been found during excavations of EN/MNA sites in this region. If these were working tools, one certainly ought to find at least some in such circumstances. Secondly, pieces of ground flint – which might indicate that flint axes were used at the sites – are very rare. In recent re-analyses of 44 EN settlement sites, ground flint was not identified (Bergsvik 2006; Solheim 2009). Excavated sites dated to the EN/MNA transition in Rogaland have a few fragments: Holeheia (1), Slettabø (6) and Gjellestadvige (3) (Bang-Andersen 1981: 64; Skjølsvold 1977: 64; 1980: 29), which represents no more than 0.01% of the total amount



of flint artefacts at these sites. A more recent revision of the Slettabø site carried out by Håkon Glørstad has however produced a higher number of ground flakes (Østmo 2008:78). It may, however, somewhat blur the picture at Slettabø that some of the ground pieces may be related to the MNB phase at the site. Even so, an impression of more realistic numbers of ground flints is provided by recent investigations of a couple of large, coastal Neolithic sites farther southeast on the Norwegian coast; at Auve in Vestfold, SE Norway 786 or 0.84% of a total 93730 flint pieces were ground (Østmo 2008:78) and at Hæstad in Aust-Agder on the southern coast 226 ground flints have been identified, comprising 0.38% of the total 59831 (Resi 2000:16ff). For western Norway, this seems to indicate that although some of the axes in the analysis may have been deposited at settlement sites, this obviously was an infrequent practice compared to eastern Norway.

Five of the axes (S2657, B3221, B9911, B9977 and B11643) have been found in bogs, and may be the results of offerings in wet environments. Two of these are almost certainly such; one was found in a bog at the top of a small hill (B9911), and the other close to a possible structure in the bog (B9977). The three remaining of this category are less obvious as offered deposits. They could have been deposited at dry-land settlements that were later covered by bogs. However, since axes or axe fragments are so rarely found at residential sites, this seems unlikely. Blade S8070a has also most likely been offered. It was found at 1 m depth close by a large stone beside a small creek, together with other artefacts. By contrast, the two axes reported to have been found in gravel (B9227 and B7668) may have come from simple, flat graves, similar to several finds in southeast Norway and in consideration of the types of flat graves identified within the TRB in south Scandinavia, (cf. Ebbesen 1994; Østmo 2007). Half of these axes are typologically certain and completed.

Admittedly, the limited data on finds contexts does not take us very far. It may be concluded that some of the axes were deliberately offered, that a couple are from graves and that a few possibly stem from residential sites. It does, however, appear reasonable to assume that most of the axes have been deposited intentionally in the ground.

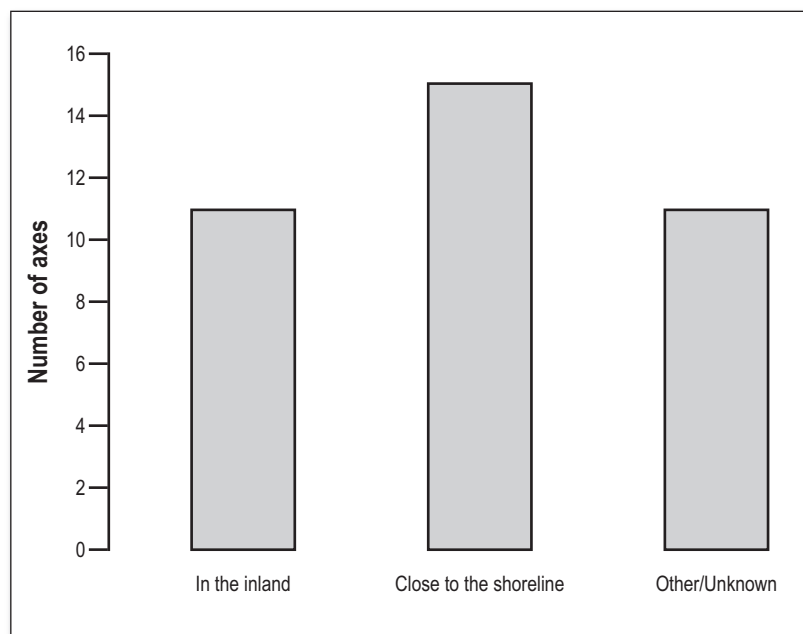
Another way of considering the context of axes is to look at the elevation of find locations, using the 30m contour line to distinguish between *shoreline* and *inland* recoveries. Shore-

bound settlement sites during the EN/MN in the relevant area were usually situated 5–10m above the contemporary shorelines. Elevation data were calculated for all axe blades in this analysis and were then compared to similar data obtained on Vespestad/Vestland adzes from Gulen and the NW part of Hordaland (Fig. 1). These two regionally common forms cover the same period as the TRB axes; Vespestad adzes mainly dating to the EN, while Vestland adzes are largely MNA. In order to make the two sets of data strictly comparable, only stray finds of Vestland/Vespestad adzes – not those found during archaeological excavations – were included. TRB axes have an equal share of inland and shore-bound locations (Fig. 4).

This contrasts with the distribution of the regionally distinct adzes from the test area, for which a much larger share were found at shore-bound locations (Fig. 5). These different patterns are intriguing, and indicate strongly that there were different deposition practices for these two general categories.

What do these differences mean? In a previous study, the elevation of find-spots of imported MNB axes and LN daggers was recorded from Gulen and the northwestern part of Hordaland. This was interpreted as an indication of the initial colonisation of the inland of this area related to cultivation and husbandry during the MNB/SN (Hjelle et al. 2006:162). Similar patterns for the TRB axes studied here invite similar interpretations. However, other data do not support a model reliant on cultivation or husbandry, at least not this early. Palynological data indicating agriculture in the EN and MNA are only available from

Fig. 4.
The relation to the shoreline of the TRB axes in western Norway.



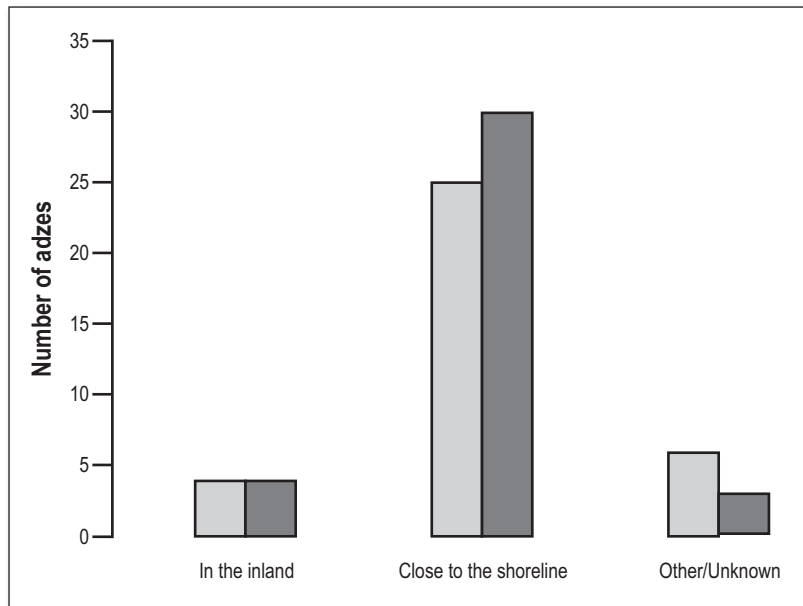


Fig. 5.

The relation to the shoreline for Vespestad adzes (light grey) and Vestland adzes/chisels (dark grey) found in the test-area in northern Hordaland/Gulen.

sites close to the shorelines. Under these circumstances, the distribution/deposition of axes in the inland zone may relate to a new way of perceiving the landscape. *Inland* was no longer an area used only from time to time. Once cleared, it could be used for dwelling, not just for hunting and gathering expeditions from coastal settlements. The axe was crucial to this change of view. These values would diverge radically from the traditional hunter-fisher lifestyle and ideology, where a strong relation to the shores appears to have been important (Bergsvik 2009b).

The TRB influence in western Norway

Based on the above it is possible to argue that several expressions of the TRB were present in western Norway, among them pottery making and limited agriculture. TRB axes were also known and used, and were deposited in ways and places that echoed practices in eastern Norway. While some of these features are found most extensively and in the largest quantities in the southern part of the area, axes are present across the *entire region*. Taking into consideration that these different features were distributed in relatively similar ways chronologically as well as spatially, it seems reasonable that they were interlinked; that they together should be seen as a “package” related to the TRB, particularly in Rogaland and Hordaland.

The question that remains is how significant this was in local culture? In a recent contribution, Fredrik Hallgren has argued that, since diagnostic TRB features are present, western

Norway should be seen as integrated in the TRB culture. This is based on an understanding of TRB as a regionally diversified phenomenon, particularly during the MNA period (Hallgren 2008:247ff). This is also the opinion of Håkon Glørstad, who argues that the TRB culture was not restricted to the Oslo fjord. Instead, he maintains that it extended much further along the coast and included Rogaland (Glørstad 2005:48). As related initially, we have chosen to identify TRB material in Norway on the basis of a similarity with that found in south Scandinavia. It is however clear that the Scandinavian TRB is only a part of a vast cultural complex extending over most of Northern Europe (Midgley 1992). As we have demonstrated, TRB material is indeed present in Western Norway. However, we consider that the finds of unambiguous TRB artefacts are too few – even in the southern part of the region – to make it reasonable to include Western Norway and its culture in the sphere of the TRB proper, in particular when the overwhelming majority of Neolithic finds from the region are of local types arguably having little or nothing to do with the TRB or influences from it. This applies to ceramics as well (see Østmo 2008:187 with references and discussion). The Neolithic of western Norway is probably better explained in terms of the majority of its material, important in its own right and as a context for assessing the significance of materials and ideas imported from elsewhere.

Instead of being considered a branch of the TRB culture, the western Norway Neolithic should instead be characterised as made up of coastal hunters and fishers, among whom economy, settlement patterns, regional boundaries, exchange networks and probably ideology were deeply rooted in the preceding Mesolithic period. This was the case at least until well into the MNB period. The TRB was important for local populations, particularly in the south, but this was a partial and varied process. Many TRB axes were probably regarded as valuable objects with long life histories. Before their deposition, they had been carried for considerable distances, and they had perhaps changed hands many times. It is very likely that there were a number of connotations and associations related to them, which had to do with their places of origin, and to places or people on their western route. Some of these connotations may have been related to the landscape. Landscape perception during the EN was quite clearly very different among eastern and western groups. While the western groups lived most of their lives close to the



shoreline and spent very little time in the forests, the inland was much more integrated in the lives of the eastern and particularly the southern Scandinavian TRB groups. This difference in the use of the landscape in eastern and western Norway was marked already during the late Mesolithic period.

We argue that the imported TRB blades contributed to changes in ways of thinking about the landscape in the west. As material manifestations of distant populations, among whom the inland was used for working, dwelling and offering, the axes loosened up the traditional and strong relationship between humans and shorelines among the western hunter-fishers. When engaged in practical and ritual activities in the inland forests, they literally opened up a landscape which until then had been irrelevant for residential purposes. In reality they were the first steps towards more fundamental economical, social and ideological changes in western Norway.

Conclusion

During the EN and MN, western Norway was inhabited by sedentary hunter-fishers. Through contact networks with TRB groups living in the east and/or the south, these populations had adopted agriculture, which was practiced on a low scale. TRB elements, such as pottery, point-butted axes, thin-butted and polygonal axes and double-edged axes have also been found in this area. Here, 37 TRB axes have been reclassified and described in terms of chronology, distribution, condition, and deposition. Most of the axes were probably imported during the latter part of the EN and early part of the MN (middle TRB). They were almost certainly brought to western Norway along the coast from the Oslo fjord, and concentrate in the southern part of the region. None of the axes are found at settlement sites. Generally they are in good condition, which indicates that they may have been regarded as valuable objects at the time of deposition. Quite a few of the TRB axes were deposited inland at elevated locations in the terrain, in line with eastern and south Scandinavian practices, and in contrast to the western tradition of depositing adzes close to the prehistoric shorelines. This seems to indicate the adoption of a new way of perceiving landscape which was linked to the axes themselves and which contributed to a disintegration of the old hunter-fisher ideologies towards the end of the middle Neolithic.

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The Nøstvet axe

Abstract

The Nøstvet or Lihult axe is the main defining artifact of the long lasting Nøstvet/Lihult complex in Western Sweden and Eastern Norway. The main area of distribution is around the Oslo fjord, along the coast of Bohuslän and in the western parts of Lake Vänern.

The axe is defined as a core adze, produced by flake reduction of the core and with a ground edge section. Usually the cross section is triangular. The blades are made of local bedrock and ice transported raw material. Different raw material dominates in different areas. The axes are dated to the late Mesolithic, but seem to be rare at the transition to the Neolithic.

Nøstvet axes are mostly found at settlement sites situated close to the coast in the Mesolithic. The settlements are located in areas which lent themselves to a broad spectrum economy, or where a smaller number of resources would have been very abundant.

Because of their coast bound distribution, many researchers have concluded that they must have something specific to do with coastal life. A popular recent hypothesis has been that they were used for making dugout canoes. If one accepts the link with canoes, then it is easy to see a connection between the axes and the networks of transport, contact and communication within which Late Mesolithic communities are likely to have been set. It looks like canoes did not routinely carry humans to foreign shores at this time, partly because of the dugouts' limited utility as a sea going vessel. Thus Nøstvet axes helped define the shape and size of social networks. The stability of the axe type was thus perhaps an equivalent to the stability of local society.

Brief research history

The Nøstvet axe is the most important artefact for defining the Nøstvet culture, complex or phase in Western Sweden and Eastern Norway (Andersson & Wigforss 2004:75). These axes occur regularly together with other key artefacts such as keeled cores, handled cores, microblades, grinding slabs, flake knives and heavy borers (Cullberg 1972; Welinder 1973; Mikkelsen 1975a, b; Lindblom 1984; Sjögren 1991; Nordqvist 1999; Berg 1995; Ballin 1998; Andersson & Wigforss 2004). The phase makes up approximately 1700 years of the Late Mesolithic, from 6300 BC to 4600 BC or 7500–5800 BP (Jaksland 2001; Glørstad 2002a), a period of relatively stable organisation within which processes of development in artefact assemblages can nonetheless be seen (Berg 1995, 1997; Ballin 1998; Boaz 1999; Glørstad 2004).

The Nøstvet axe was ‘discovered’ as an artefact in the 1870’s, when Swedish and Norwegian scholars recorded settlement sites with core axes made of local bedrock. The first large find in Norway came from the farm Nøstvet in Ås, Akershus. In Sweden, the *locus classicus* was found at the farm Lihult in Skee, Bohuslän (Brøgger 1905; Alin 1955; Andersson & Wigforss 2004; Jaksland 2006). The names of these two farms, Nøstvet and Lihult, denote the

same types of axes and artefact assemblages (culture) in Norway and Sweden respectively. Although the scholars were aware of the many similarities between the Lihult and Nøstvet cultures, the use of two distinctive names for what is clearly the same complex have persisted. In this article, the term Nøstvet is used throughout. (Fig. 1)

Definition of the type

The Nøstvet axe is defined only rudimentarily in the literature (e.g. Brøgger 1905:4; Shetelig 1922:104–115; Fredsjö 1953:13,21; Mikkelsen 1975a:65; Jonsäter 1984:24; Andersson & Wigforss 2004:75). The typical examples are, however, easily recognised; core axes made through flake reduction. According to Anton Wilhelm Brøgger, axes can be described in three planes. These are the front plane, showing the whole edge bow, the side plane, showing the angle of the edge and finally, the neck plane, showing the cross section (Brøgger 1906). Following this system, the typical Nøstvet axe has one flat and one vaulted surface in the side plane perspective. In the front plane, it has a near pointed butt, parallel sides and a bold edge bow. The cross section is triangular, and used axes are generally characterised by a ground cutting edge which is, for want of a better term,

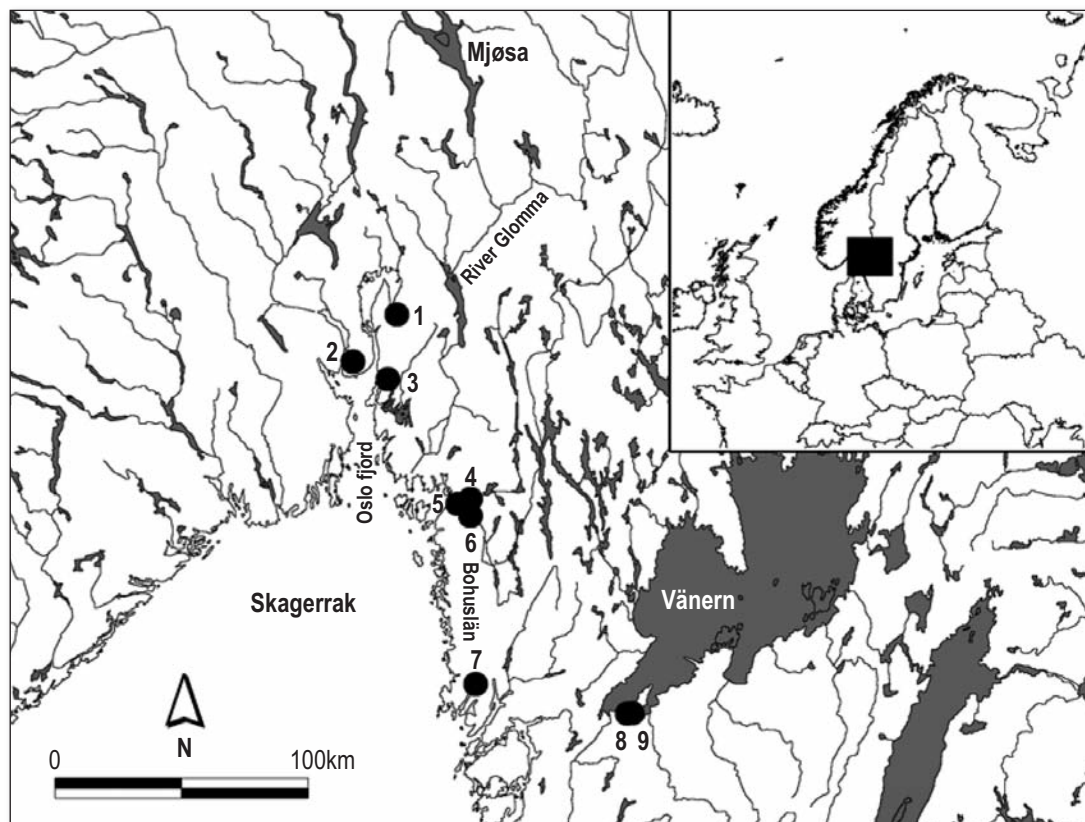


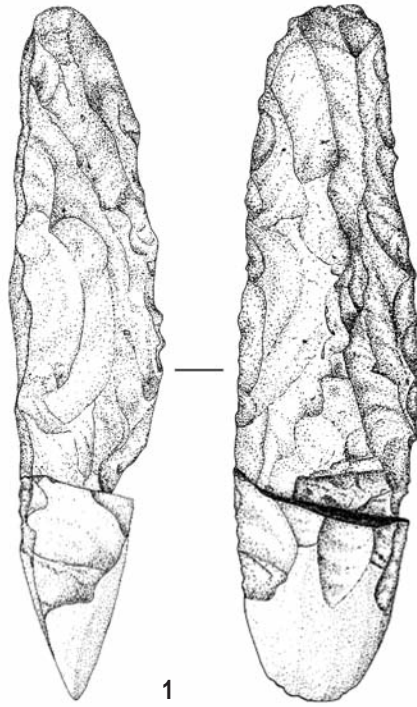
Fig. 1.
Sites discussed in the text.

- 1:
The Nøstvet site
(*locus classicus*);
- 2:
Liltvet;
- 3:
Knapstad and
Stavengåsen;
- 4:
Saugbrugsforeningens
tomt, Halden;
- 5:
Berget, Bjällvarpet;
- 6:
The Lihult site
(*locus classicus*);
- 7:
Dammen;
- 8:
Halle- and Hunneberget;
- 9:
Margreteberg.



Fig. 2.

A typical Nøstvet axe
from the Berget site.
Source: Jaksland 2002.



hoof shaped in profile. In almost all cases, the cutting edge is the only part of the axe surface which is thoroughly ground. On the rest of the surface, scars from the knapping process are clearly visible. Some axes also have a cutting edge made exclusively by flaking. Most of these are not, however, used, and the typical pattern seems to be that the finished Nøstvet axe generally had a ground edge (Jonsäter 1984:26; Glørstad 2004:27; Jaksland 2005:47). Nøstvet blades were most likely hafted as adzes (Fig. 2).

Different subtypes or variants on this typical form are often recorded (Brøgger 1905; Alin 1955; Svensson 1988:28; Andersson & Wigforss 2004:75–76; Jaksland 2005:40–44). The cross section can vary from triangular to trapezoid, via rhombic to semi-circular shape. The neck is more or less pointed and the sides, from edge to neck, can sometimes converge. Common attributes for all axes are however shaping through flaking technology, the concentration of grinding to the edge section and adze-like hafting. Despite the different variants of Nøstvet axes, this roughly defined type seems to be a stable feature in the artefact inventory for much of the late Mesolithic. One of the main reasons for the individual variation of the axes is likely the choice of blanks. Some types of bedrock possess natural cleavage planes, other fractures into fixed blocks. The size of the grains or crystals of the bedrock are also crucial for the knapping process. Different variants of the axe type are thus likely to have developed as a function of these factors (Brøgger 1905:19–26; Jaksland 2005:70).

Raw materials

Since archaeologists first identified the Nøstvet axe, the raw materials chosen for blade production have attracted considerable interest (Brøgger 1905; Berg 1995; Bengtsson 1993, 2003; Bergström 2001, 2003; Jaksland 2005). Brøgger claimed that patterns of choice reflect selection of materials that closely resembled flint. In other words, preferences tended towards materials with a homogenous small-grained mass, enabling controlled, conchoidal, fracturing during the flaking process. Selected materials also generally possessed a significant degree of hardness, allowing resilient edges and durable working (Brøgger 1905:5–8). These long standing arguments have their critics; making flint the standard measure does not allow for the proper analysis of the particular qualities of other raw materials that were sometimes used (recently Eigeland 2007; Bjerck 2008). However, the considered *choice* of flaking as the main method for Nøstvet blade production did encourage the selection of raw materials with a potential for regular, conchoidal, fracturing.

The question of flint and alternative raw materials deserves a few more comments. Flint nodules are not found in the bedrock in those areas where Nøstvet blades are commonly found. However, flint nodules are rather generously distributed along the western coast of Sweden and in the Oslo fjord area of Norway by glacial activity and by the Baltic Stream, the quantity of flint increasing the closer one gets to those areas of Southern Scandinavia where flint *does* occur in the bedrock (Andersson *et al.* 1988:102–103; Berg Hansen 1999, 2001; Andersson & Wigforss 2004:88). As a function of these processes, in the southern part of Western Sweden, core axes of flint are commonly found together with Nøstvet axes on settlement sites (Andersson & Wigforss 2004:81). In Northern Bohuslän and in Norway however, fragments of such flint axes occur only sporadically (Jaksland 2002:48, 2003:250; Johansson 2006:121–122). This must, to a considerable degree, be due to the availability of high quality flint. In areas with little or no flint, axes made from this material are rarer and were more frequently reused as raw material for smaller tools (Jaksland 2002:43, 2003:252).

Instead of flint, the West coast of Sweden and the Oslo fjord area are characterised by several excellent alternative raw materials, which were used for Nøstvet blade production. In fact, the Nøstvet complex is itself rather intimately connected to a geological phenomenon in the Oslo area (Holtedahl 1953). This takes the form



Oslo Area

0 25km

- Dip and strike of Permian fault blocks
- Fault
- Rhomb porphyry dike
- Volcanic vent breccia
- Biotite granite
- Ekerite
- Nordmarkite
- Akerite
- Lardalite
- Kjelsås-larvikite
- Volcanic neck, Oslo-essexite
- Rhomb porphyry congl. (Oslofj.) Congl. (Alnsjø)
- Rhyolitic quartz porphyry, aplite
- Trachytic porphyries (in part intrusives)
- Latitic to trachytic porphyries
- Basalt and rhomb porphyry flows
- Caledonian thrust front
- Ringerike Sandstone
- Marine Silurian
- Marine Cambrian and Ordovician
- Vangås Formation and Ekra Shale
- Moelv Tillite and Ring Formation
- Biri Limestone and Shale
- Biskopås Congl.
- Brøttum Formation
- Carbonatite rocks etc. (Fen area)
- Precambrian gneisses

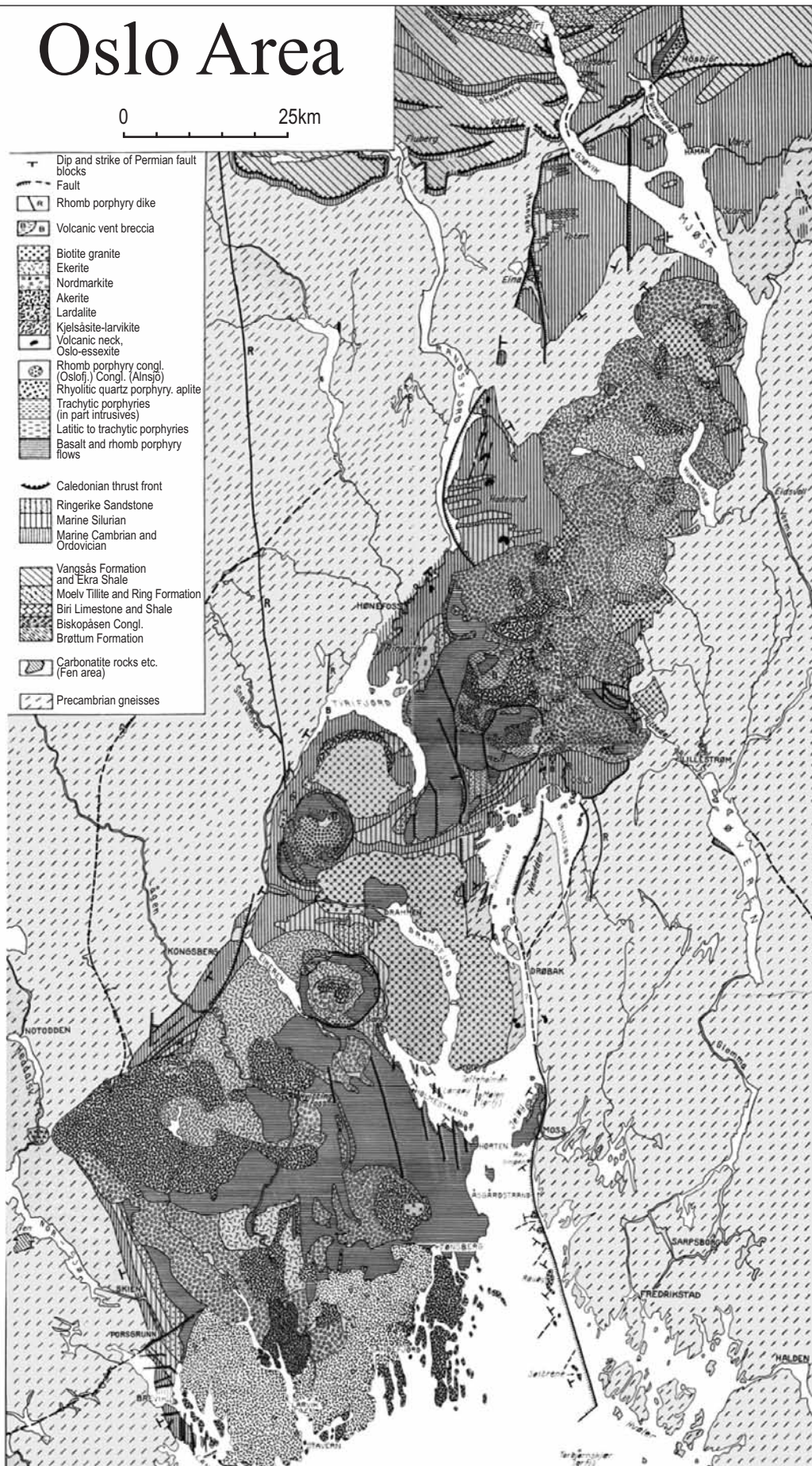


Fig. 3.
The Oslo Area.
Source: Holtedahl 1953.

of a very complex paleorift, dividing the Precambrian Baltic shield from the outer Oslo fjord up to Lake Mjøsa, consisting of eruptives, metamorphic and sedimentary bedrocks (Fig. 3). These bedrocks provided the raw material for Nøstvet axe production in Norway and Northern Bouslän (Brøgger 1905; Alin 1955; Bengtsson 1993; Bergström 2001, 2003; Jaksland 2005).

The same processes that created the Oslo area paleorift also created two large outcrops of diabase in the Lake Väneren area, the Halle- and Hunne-berget, both of which were of some importance for axe production (Bergström 2003). Glacial activity also scattered several different types of stone all over the Oslo fjord and Bouslän area, making a variety of suitable raw materials accessible practically everywhere along the coast (Danielsen 1970; Bengtsson 1993). Two types of bedrock from the Oslo area appear to have been of particular importance for Nøstvet axe production; hornfels and diabase, which were favoured for axe making where they were found (Brøgger 1905; Bergström 2001, 2003; Jaksland 2005). Thus on the western side of the Oslo fjord and in the fjord bottom, where hornfels of good quality are easily available, axes made of this raw material seem to dominate (Brøgger 1905; Mikkelsen 1975a; Jaksland 2005). On the eastern side of the Oslo fjord and in Western Sweden, axes made of diabase are the more common (Berg 1995; Bengtsson 1993, 2003; Bergström 2001, 2003; Tørhaug 2003; Andersson & Wigforss 2004:75).

Dating of the axes

The Nøstvet axe is the '*fossile directeur*' of the Nøstvet complex. The dating of this artefact is therefore important for the dating of this archaeological culture as a whole. Many scholars date the beginning of the Nøstvet phase/complex to approximately 6400 BC (7500 BP) (Mikkelsen 1975b; Lindblom 1984; Berg 1995; Ballin 1998; Jaksland 2001; Glørstad 2002a). These arguments make much of the evidence from two ^{14}C -dated sites in particular; Dammen, in central Bohuslän and Trosterud 1, on the eastern side of the Oslo fjord. Dammen (Schaller Åhrberg *et al.* 1996; Schaller Åhrberg 2007) gives a possible *terminus post quem* for the introduction of Nøstvet axes (Kindgren & Schaller Åhrberg 1999). Sealed cultural layers at the site are ^{14}C -dated to 8000–7500 BP or ca 7000–6400 BC. No Nøstvet axes are found in the cultural layer, only core and flake axes of

flint and a pecked, round-butted stone axe are recorded. A possible blank of a Nøstvet axe is included in the catalogue from the site, but this object is considered as indistinct.

Trosterud 1 has yielded two ^{14}C -dates of relevance. The oldest is 7745 ± 75 BP (TUa-1549), calibrated 6600–6460 BC. The youngest is 7435 ± 75 BP (TUa-1548), calibrated 6370–6175 BC. 5 Nøstvet axes are found on this site. If the oldest dating is accepted, Trosterud 1 has given one of the oldest ages for the introduction of this artefact type (Berg 1997:43; Jaksland 2005:34). While some scholars have questioned the interpretation and classification of the site (Jaksland 2001:36, 2005:37; Eigeland 2006:96), a small group of newly ^{14}C -dated sites from Eastern Norway has given a similar *terminus post quem* (Jaksland 2005:34; Melvold 2006). This gives some statistical support for an initial dating of this artefact type back to 6600–6500 BC. Several sites in the Oslo fjord area, dated according to the shoreline displacement curve, also seem to indicate an introduction of Nøstvet axes between 6400 and 5900 BC (Ballin 1998; Johansen 2003; Berg 1995, 1997).

The *terminus ante quem* for the production and use of Nøstvet axes can be estimated with reference to four ^{14}C -dated sites on the eastern side of the Oslo fjord. At Berget 1, a fire place situated in an area of Nøstvet axe production and use was dated on charcoal to 5965 ± 75 BP (TUa-3276) and 5660 ± 70 BP (TUa-3275), or 4900–4400 BC (Jaksland 2002). These dates are disputed (Jaksland 2002; Glørstad 2004), because the artefact assemblage found at the site is very typical for the Nøstvet phase and practically identical to the artefact assemblage found on an extremely well dated Nøstvet site in the vicinity (Tørhaug 2003). This well dated site is 600 years older than the ^{14}C -datings from Berget 1. Torpum 13, situated in the same area as Berget 1, was characterised by a rather different artefact assemblage. Here, Nøstvet axes are very rare; only three being found. ^{14}C -determinations from a bone found on the site and from charcoal found in a fireplace, have dated the site to 5610 ± 40 BP (TUa-4390) and 5530 ± 50 BP (TUa-3845), or 4500–4300 BC (Jaksland 2003). Saugbrugsforenings tomt 5, is well dated with ^{14}C -dates spanning 6200 ± 50 BP (TO-1849) to 5510 ± 105 (T-8816) (Lindblom *et al.* u.d.), or 5200–4200 BC. Here, no distinct Nøstvet blades were found, only a few more irregular axes of stone. At Gjølstad 33, where charcoal from a fireplace was dated to 5390 ± 75 (TUa-894) and 5330 ± 70 (TUa-893), or 4300–4000 BC (Berg 1995:88). No Nøstvet blades were found. The sites Torpum 13, Saugbrugs-



foreningens tomt 5 and Gjølstad 33 also produced flint arrowheads, a category of artefact not generally found in Nøstvet assemblages. Sites with few or no Nøstvet axes occur between 5200 and 4000 BC. The most recent dates for sites with Nøstvet axe blades appear to fall in the period 4900 to 4300 BC. Consequently it is tempting to infer that the Nøstvet axe disappears from the artefact inventory in the period 4900–4300 BC. Based on a more detailed evaluation, including sites dated by the shoreline displacement curve, I have suggested elsewhere that Nøstvet axes are not produced in the Oslo fjord area after 4500–4400 BC (Glørstad 1998, 2004).

Current evidence suggests that the production of these distinctive blades began around 6600 BC and ended c.5000 BC. It also seems that this industry began and ended with blade production at a rather low scale. The zenith of Nøstvet axe production seems to occur in the second half of the sequence, around 6500–6200 BP or 5500–5100 BC. BC, and there are hints that this part of the sequence saw production undertaken on a larger scale. It is within this same part of the sequence that we find very large Nøstvet sites, where the number of Nøstvet axes can run to several hundred (Glørstad 2002b, 2004; Jaksland 2005). Production on a relatively large scale may thus be a characteristic of the main Nøstvet phase or complex (*op cit.*), making the 'typical' Nøstvet assemblage a rather late phenomenon in the Nøstvet phase. (Fig. 4)

Production

One of the characteristic choices in the making of Nøstvet blades was the common selection of a natural cleavage plane as a platform for further reduction. Many axes still retain this plane on their undersides and it seems that blanks that allowed for shaping through controlled platform reduction were often preferred (Jaksland 2005:41–44). After the axe was shaped through flaking, the edge was usually ground on sandstone slabs. The connection between such slabs and Nøstvet axes is a very close one. The association of flakes from core reduction, blanks, discarded/destroyed axes, and sandstone slab fragments is very common on many settlement sites (Jonsäter 1984; Glørstad 2004; Jaksland 2005). Indeed, this combination occurs as a distinctive complex within a number of sites (Jonsäter 1984:26; Jaksland 2002; Tørhaug 2003). Production, use and maintenance therefore seem to be part of an operational chain that was frequently located in the same place (Fig. 5).

This pattern is interesting because of the contrast that it offers. Stone axes have attracted a lot of interest among scholars because they can often often shows signs of special, ritualised treatment. Raw materials were sometimes collected at specific, significant places, to be distributed as blanks or finished axes over large distances (e.g. Bradley & Edmonds 1993; Alsaker & Olsen 1984; Bergsvik & Olsen 2003; Malmer 2002; Taffinder 1998; Klassen 2004).

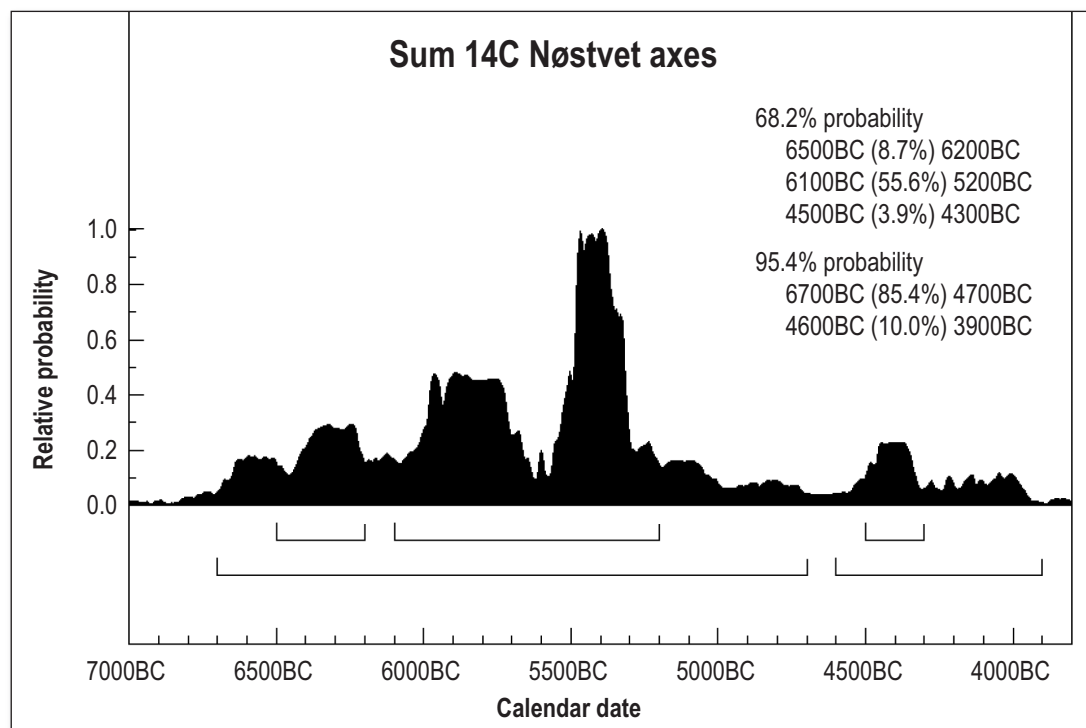


Fig. 4.
 The sum of ^{14}C -dates
 from sites with
 Nøstvet axes in the
 Oslo fjord area.
 Datings obviously
 too young have been
 left out of the plot.
 Diagram made in
 OxCal 3.10.





Fig. 5.
Nøstvet axe and
sand stone grinding slab
from the Berget site.
Source: Glørstad 2004.

Such a pattern is hard to establish with Nøstvet axes. In the Oslo fjord area, no regular quarries or mines for extracting raw material have so far been found. Examination of the stones used for production at Nøstvet sites strongly indicates that suitable raw material was taken from the vicinity where it was ready to hand, collected in moraines exposed on riversides and shores. Glacial distributions of material from the Oslo paleorift also made suitable stone accessible practically everywhere (Brøgger 1905; Gjessing 1945:81; Bengtsson 1993; Jaksland 2005; Johansson 2006; Bergström 2001, 2003). The various stone types found as flakes on the dwelling sites in the Oslo fjord district, also points towards heterogeneous and expedient strategies for collecting raw materials near the settlement site. This picture can also be extended to the west coast of Sweden. Here too, axe blades seem to be made from the rocks found in moraines or in the local bedrock (Alin 1955:187; Kindgren 1991:62–63; Bengtsson 1993, 2003; Lindgren & Nordqvist 1997:68; Johansson 2006).

There are, however, a few examples of a slightly different pattern which deserve comment. Knapstad 114 in Akershus (Berg 1995, 2003 (Fig. 6)) is the only one in the Oslo fjord district where regular quarrying has been recorded. Here, raw material was extracted from an outcrop of a diabase dyke. Although the scale of working was not that large, more than 35,000 flakes and pieces of diabase were recorded at the site. At Stavengåsen 121, nearby, flakes that probably originated from this quarry were detected. Some of these were refitted and formed a negative image of a Nøstvet axe (Berg 1995; Olstad 1995). This indicates that blanks and raw materials of a suitable size were taken from the quarry site and remade into axes on settlement sites nearby. Something similar

is seen at Bjällvarpet in Bohuslän, situated south of the border between Norway and Sweden and dated to the end of the Nøstvet phase (Johansson 2006). Approximately 16,000 artefacts were found here, c. 12,000 of them of stone. Flint artefacts made up only 15 percent of the artefact assemblage, which is an unusually small amount at Nøstvet sites. Most of the stone artefacts are flakes from axe production and 33 axes were recorded. The raw material originates in the Oslo paleorift. The axes are present in all stages of their operational chain; from blanks to worn out pieces (Johansson 2006:109, 112).

Margreteberg in Västergötland (Saraau & Alin 1923; Lindgren & Nordqvist 1997; Nordqvist 2000b) is also interpreted as a production site. This is, however, quite different to Knapstad and Bjällvarpet. Here, axes, flakes and blanks of the same type of diabase are found, as well as hammer stones, some of them in specific deposits. The diabase probably originates from erosion zones at Halleberget or Hunneberget near Vänersborg, situated at the outlet of Lake Vänern. This raw material is excellent for Nøstvet axe production and c.700 examples have been found here. Large quantities of production debris of diabase have also been surface collected from the site (some thousand pieces). No other known site has as many axes as Margreteberg, and it is suggested that the abundance of axes and production debris can be explained by the excellent quality of the diabase at Halleberget and Hunneberget (Saraau & Alin 1923:198–205; Bengtsson 1993:139, 2003; Lindgren & Nordqvist 1997; Bergström 2001). From the quarry and production site Margreteberg, axes and blanks were presumably distributed to many sites in the Lake Vänern area. Here then, different kinds of sites in the axe production/use cycle *can* be identified

Fig. 6.
Refitted diabase flakes,
grinding slab, various axes
and a hammer stone from
the Stavengåsen site.
Photo: Museum of
Cultural History,
University of Oslo.



(Lindgren & Nordqvist 1997:68; Nordqvist 2000b). Margreteberg and the nearby production and use sites are interpreted in the same manner as the famous West Norwegian distribution of diabase and greenstone axes (*op cit.*). There, it has been possible to identify two different main quarries for axe production and two distinctive patterns of distribution, interpreted in the literature as two different territories (Olsen 1981; Alsaker & Olsen 1984; Alsaker 1987; Bergsvik & Olsen 2003).

The comparison of Margreteberg with the west Norwegian situation is interesting, but there are problems connected to the hypothesis that these sites should represent the same type or organisation of activity. The most obvious is that so few sites around Lake Vänern are excavated. Most of the finds are derived from surface collection in tilled fields (Lindgren & Nordqvist 1997:68; Svensson 1988), and it is possible that those interpreted as use-sites for Nøstvet axes, would have yielded many flakes of diabase – debris from axe production – if they had been excavated (see also Jaksland 2005 for empirical elaboration of this point). The axes from Margreteberg do not originate from only one find spot either. According to Georg Sarauw and Johan Alin, axes and debris have been collected at several places. On these sites, flint tools and production debris were also found, indicating a wider range of activities, not just axe production (Sarauw & Alin 1923:199, 200). Admittedly, they also state that flint artefacts are very few compared with the abundance of diabase artefacts, but it is important to keep in mind that the site was not excavated. In my view, Margreteberg could be readily interpreted as a large settlement site, rather than as a specialised site for axe production, a view which accords with the opinion of Sarauw and Alin (1923:205). What makes Margreteberg extraordinary is the easy and abundant access to an excellent raw material for axe production.

To sum up, the axes from the Oslo fjord area, the Bohuslän blades and those from Lake Vänern all reflect the use of raw materials that could be found nearby. No sites have clear indications of specialised large scale axe production and 'export'. Where some kind of quarrying can be documented, axes seem to have been distributed on a small scale to a limited area. On the western side of the Oslo fjord, diabase and hornfels are documented as the most common raw material (Brøgger 1905:6; Mikkelsen 1975b: 62–63). In the inner part of the Oslo fjord, axes of hornfels seem to dominate (Jaksland 2005; Brøgger 1905); and finally, in the outer part of the eastern side of the fjord diabase seems to

be most commonly used (Tørhaug 2003; Bergström 2001). Different types of diabase dominate also in Bohuslän (Bengtsson 1993) and in the western part of Lake Vänern and in the Göta River valley. In the easterly parts of the Lake Vänern, other local raw material dominates (Kindgren 1991). Therefore, even bearing Knapstad R114 and Margreteberg in mind, there are no clear indications of a conscious and restricted selection of a few quarries which were then consistently used for procuring raw material. In Eastern Norway and Western Sweden most axes were probably made from stones collected at the riversides and seashores, eroded out of moraines and other glacial deposits (Brøgger, W.C. 1905:152; Gjessing 1945:81; Bengtsson 1993; Jaksland 2005:72–73, 77, 78, 80). At the riverbanks, the seashores and the dykes the raw material probably was given a rough axe-shape. This was further refined at the settlement site where the axe was then used.

Distribution

The distribution of Nøstvet axes is fairly well mapped in Norway (Indrelid 1994; Boaz 1999; Glørstad & Uleberg 2002; Glørstad 2008) and to some extent in Sweden (Welinder 1977). As Fig. 7 shows, the patterning shows a close relationship with ancient shorelines and with large lake and river systems near the coast (e.g. Indrelid 1994; Boaz 1999; Berg 2003; Bengtsson 2003; Jaksland 2005). The main area of Nøstvet axes is also roughly the Swedish and Norwegian Skagerrak coast, from Agder, via the Oslo fjord to Halland. The western limit is Jæren in Rogaland (Olsen 1981:129–130), while to the north it is the springs of river Glomma (Glørstad & Uleberg 2002) (the largest river system in Southern Norway). The southern limit is Middle Halland (Andersson & Wigforss 2004:29). The distribution in Sweden, east of lake Vänern, is more disputed (Welinder 1977; Kindgren 1991; Lindgren & Nordqvist 1997; Knutsson *et al.* 1999; Carlsson *et al.* 2003). Most however agree that the east Swedish mainland constituted the eastern border to the spread.

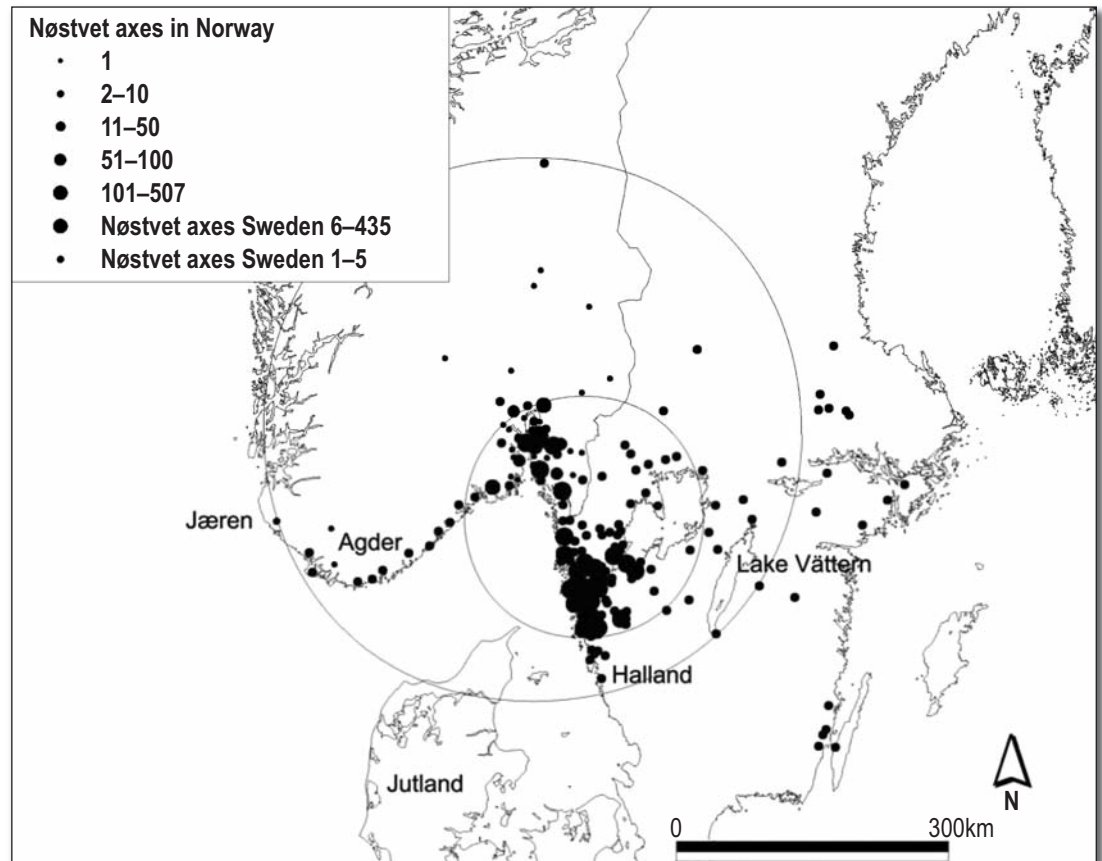
The inner Oslo fjord lies more at less at the geographical centre of the distribution. Most known sites with Nøstvet axes are found less than 300 km from this area (*see the large circle in Fig. 7*). Interestingly, this distribution is also shared by other components of Late Mesolithic assemblages, perhaps indicating that the area was effectively a 'territory' or range of influence at this time. The core area for the Nøstvet com-



Fig. 7.

The distribution of Nøstvet axes in Scandinavia.

Source: Glørstad and Uleberg 2002, Olsen 1981, Welinder 1977.



plex, that is, the area where axes are most frequently found, is much smaller. It consists of the Oslo fjord, Bohuslän, the Gothenburg area, including the Göta River and western part of Lake Vänern (see the small circle in Fig. 7). It is suggested here that this is closely related to the geology of the local area (see above).

Find context

Nøstvet axes are mostly found at settlement sites situated close to the shore in the Mesolithic. When such sites are surface collected, axes tend to dominate recovery patterns. However, excavations usually reveal large quantities of flint debris and tools, as well as pieces of grinding slabs, flakes, blanks and other detritus of blade production. These assemblages suggest a wide range of domestic activities at most sites. The composition of animal bones and shell assemblages from sites with Nøstvet axes also indicates that most sites were caught up in varied, broad-spectrum, economies. The details from excavated contexts also suggest that some of the larger sites have a considerable time depth. In the Oslo fjord area for example, some Nøstvet phase settlements are characterised by large spreads of artefacts and structures scattered over an area

of c.10,000 square meters (Glørstad 2005:361). Two such large settlement areas have so far been investigated (Lindblom *et al.* u.d.; Rønne 2003; Tørhaug 2003; Melvold 2006), and ¹⁴C-dates from both suggest that we are looking at settlement residues building up over several centuries. Given this, it is entirely possible that the recovery of several hundred axes from some of these larger sites simply reflects the accumulated residues of many episodes of essentially small scale occupation.

Excavation at several sites has identified structural remains (Johansson 1998, 2004; Jaksland 2002; Hernek 2005; Nordqvist & Hernek 2005; Wennberg 2006) and produced evidence for an association with axes. The making and maintaining of axe blades was something often done outdoors. However, flaking and trimming were sometimes undertaken inside huts – and it is clear that houses were also used for storing axes (Glørstad in prep.). In a few cases, it has even been possible to establish a connection between the axe working and use and those areas of the site closest to the shore (Tørhaug 2003; Berg 1997:54). The evidence from most settlements indicates that axes were seldom abandoned whilst in good working order. They are generally found either as blanks or as blades that were broken/destroyed beyond repair.

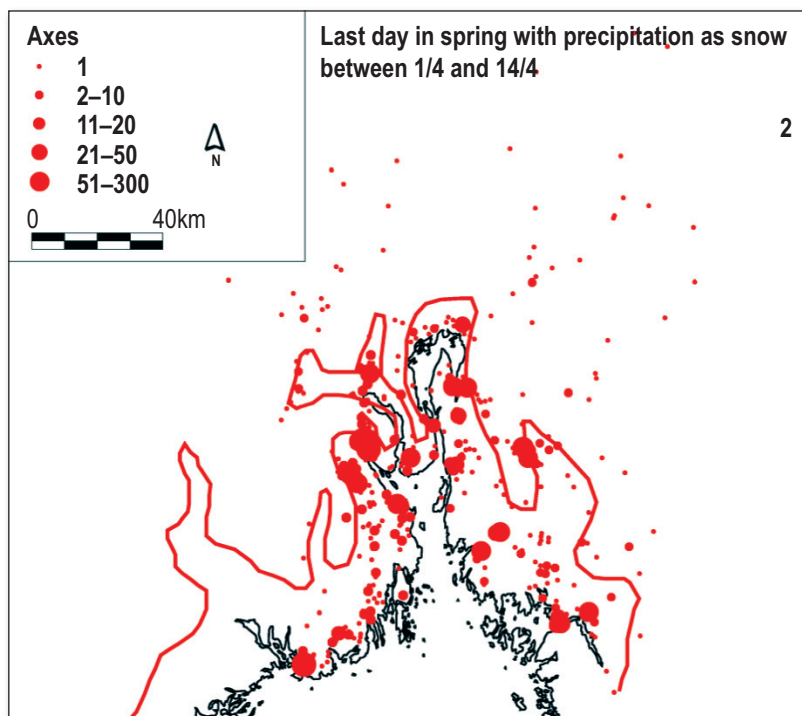


Nøstvet axes are most commonly found scattered across settlements. However, they are also occasionally found as elements within more specific placed deposits. At Liltvet in Hurum, inner Oslo fjord, 13 very similar Nøstvet axes were found in a pit dug deep in the ground (Fig. 8). All were made of the same raw material and are so similar that the same knapper probably produced them (Glørstad 2002b). They are extraordinary long and slim compared with axes commonly found at settlement sites. Unused axes are almost by definition likely to be longer than those used and discarded axes often found on settlements. However, the Liltvet axes are so long and elegant, that some kind of specialised or even ritualised production may have characterised their manufacture (*op cit.*). Placed deposits are also known from Margreteberg (Lindgren & Nordqvist 1997).

Environment, use and social significance

The largest accumulations of Nøstvet axes and contemporary settlements are located in areas which lent themselves to a broad spectrum economy, or where a smaller number of resources would have been very abundant. Typically, this includes fjord bottoms, river estuaries, inlets and outlets of large lakes, and large islands in the inner archipelago (Mikkelsen 1978, 1975a; Lindblom 1984; Kindgren 1991:57; Nordqvist 2000a:213). In the Oslo fjord region, these same areas are generally highly productive today, and Figs. 9, 10 and 11 show the distribution of Late Mesolithic axes and the areas where winters currently end first, where summers first begin, and where the summer temperature is at its highest. It is perhaps reasonable to assume that these conditions were also of significance in the Mesolithic, an assumption supported by the high densities of axes in those with a high density and/or diversity in biomass.

Within these broader distributions, the densities of blades require us to ask why so many are found on particular Nøstvet sites. Because of their coast bound distribution, many researchers have concluded that they must have something specific to do with coastal life (Kindgren 1991; Indrelid 1994:287; Nordqvist 1995; Boaz 1999; Glørstad & Uleberg 2002; Berg 2003). Most probably saw use for working wood and other rather hard organic materials. The shape of the axe and the edge design, indicate that the axes were very suitable for gouging and a popular recent hypothesis has been that



they were used for making dugout canoes (Mikkelsen 1975b; Alsaker 1987; Østmo 1995; Berg 1997; Glørstad 2002b, 2006; Jaksland 2003, 2005). This does not entirely exclude other functions, but as Einar Østmo points out (Østmo 1995), the dugout canoe was probably one of the largest and most complicated wooden structures made by the people of the Nøstvet phase. No dugout canoes or any other vessels have actually been found in the area of the Nøstvet complex, so the hypothesis is strictly

Fig. 8. (top)
The deposit of Nøstvet axes from Liltvet.
Photo: Ellen Holte, Museum of Cultural History, University of Oslo.

Fig. 9.
Climate zone showing an early end of winter.
Source: Bjørnbæk 1993.

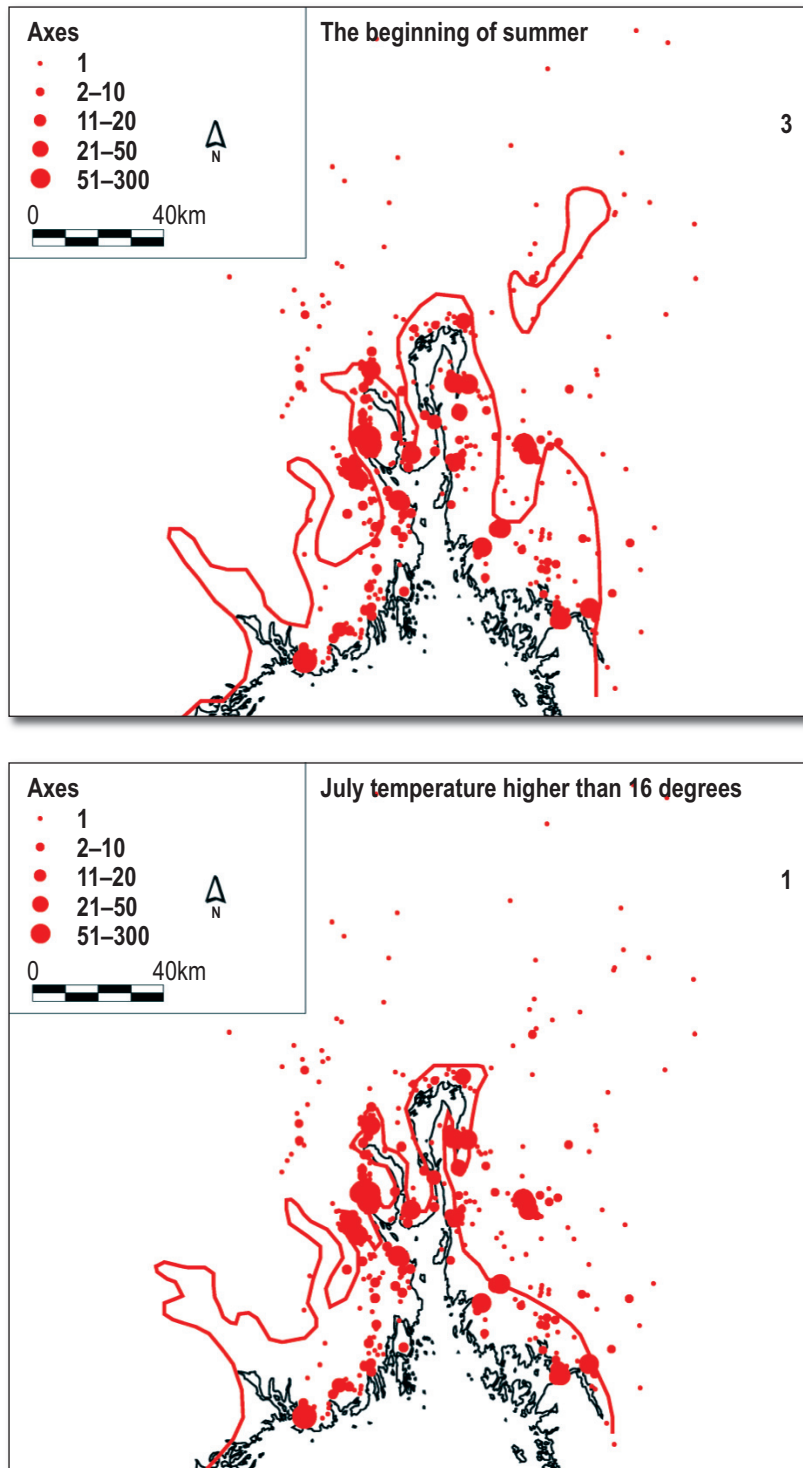


Fig. 10. (top)
Climate zone showing
early beginning
of the summer.
Source: Aune 1993b.

Fig. 11.
Climate zone showing
highest summer
temperatures.
Source: Aune 1993a.

unproven. However, since all the vessels known from Late Mesolithic South Scandinavia are dugout canoes (Andersen 1995; Christensen 1997:284; Crumlin-Pedersen & Trakadas 2003: 218), and were therefore common immediately south of the Nøstvet complex, it is a hypothesis that remains attractive.

With only one exception, all the dugouts of Southern Scandinavia are made of linden (Andersen 1983, 1995; Christensen 1997:284). Linden is very soft and easy to shape and was

common in the second half of the Atlantic period (Hafsten 1956:79; Danielsen 1970:97), when most of the sites with Nøstvet axes were occupied. It could be found south of a line drawn from the estuary of Lake Mjøsa, to the estuary of Lake Tyrifjorden and to Lake Nordsjø in Telemark (Høeg 1997:16). This corresponds with the northern limits for almost all Nøstvet axes so far identified (see Fig. 12). This may be indirect support, but it does point towards a connection between dugout canoes and Nøstvet axes (Jaksland 2002, 2005; Glørstad 2002b, 2006). It may also be significant that some of the largest concentrations of axes are found in landscape settings where logs suitable for making dugouts would have been readily available.

Insights from Danish experiments in the making of Linden dugouts are also useful here. A number of these have been made using only stone tools, providing very rough indications of what was involved. Of the 15 flint axes used in these experiments, four were destroyed in the process, largely due to a lack of knowledge or *savoir faire* in their use (Christensen *et al.* 1979). This suggests that in skilled hands, one axe blade (or very few), might well be enough to make a canoe. Even if one calculates a slighter higher rate of destruction for axes made of diabase and hornfels, the Danish experiment indicates that only a few axes would have been needed for tasks such as this. On the larger Nøstvet sites, those with hundreds of axes, it is therefore possible that boat production was undertaken on a considerable scale. Here again, however, it may be simpler to see this as a consequence of time depth, and of accumulated episodes of occupation. A new boat was made every four to eight years would be enough to account for known densities (Glørstad 2008). The value of this calculation is certainly questionable. My point is simply to suggest that the number of axes used and vessels made, need not to be particularly impressive and certainly not on any significant social scale beyond that of local communities.

These insights provide clues as to the possible social significance of Nøstvet axes. If one accepts the link with canoes, then it is easy to see a connection with the networks of transport, contact and communication within which Late Mesolithic communities are likely to have been set. The distribution of the Nøstvet complex and the (experimental) experience from sailing dugouts suggest that these networks were articulated via inland waterways and inshore sheltered waters. It looks like canoes did not routinely carry humans to foreign



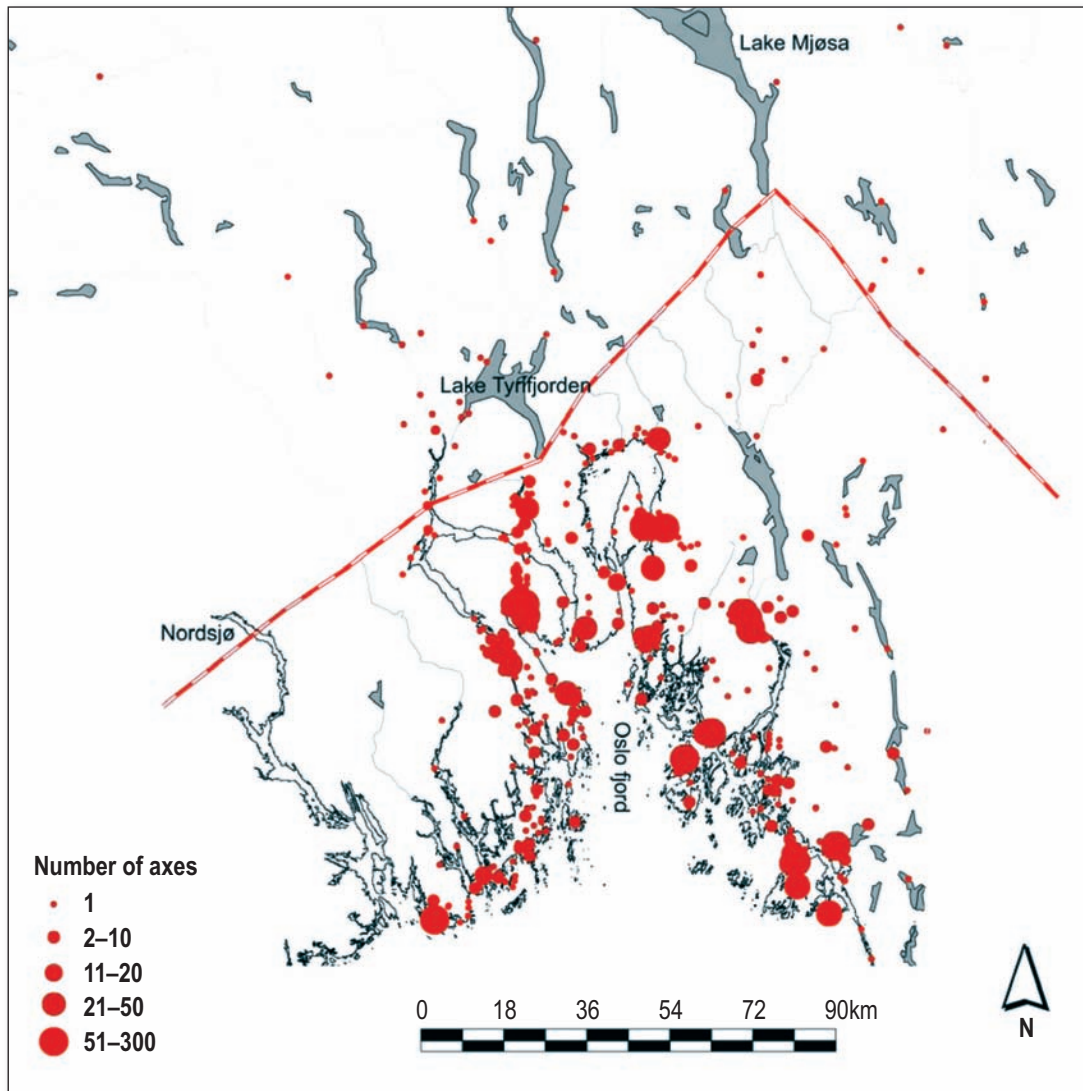


Fig. 12.
The northern borderline
for spread of linden
in the Atlantic
(source: Høeg 1997)
and the distribution of
late Mesolithic axes.

Water level is raised to
50 meters above the
present, to give an
impression of the
Mesolithic coastline.

shores at this time, partly because of the dugouts' limited utility as a sea going vessel (McGrail 2001:172). It was in the archipelagos, the fjords, lakes and rivers that this kind of boat was most useful. The boats therefore opened up the world, but in a limited manner. Judging from the distribution of axes and other things, they gave the people of the Nøstvet complex a locally defined region, stretching from Jæren in the West, Halland in the South, Lake Vätter in the East and the springs of the River Glomma to the North (an area of approximately 280,000 square kilometres). For many and for much of the time, the horizons of day to day life were probably even closer. The more limited distribution of some raw materials (e.g. Kindgren 1991:57), suggest that the area of routine activity for some groups could have been c.5000 square kilometres. However, the broader, archaeological, patterns suggest an awareness of this larger scale, even if it was an awareness realised 'on the ground' rather than as we see things – on a map.

Within these conditions, axes connected people to certain places in the landscape; to spreads of raw material and areas where blades saw use. Even the outcome of the work defined relationships in a particular manner: the axes were used to make vessels that made people mobile albeit in particular, limited and local ways. The complex of dugouts and Nøstvet axes could thus be interpreted as a set of material conditions that helped to define the world and make it predictable. The stability of the axe form – a tradition maintained for more than a thousand years – can also perhaps be seen as an aspect of a relatively stable, centripetal, social network. Like dugouts themselves, the social world defined by the making and using of Nøstvet axes was relatively limited. Skill in these (and other) forms of making were no doubt locally significant in many respects. For the purposes of this paper, what matters is that in making dugouts possible, Nøstvet axes helped define the shape and size of social networks. The stability of the axe type was thus perhaps an equivalent to the stability of local society.

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■■■ Found in 1868 during the construction of the North East Railway's gasworks, the York Hoard is one of the more remarkable collections of stone and flint artefacts found in North Yorkshire. At the time of discovery, in a pit small enough to be *covered by a man's hat*, the hoard was sizeable, including many axes, laurel leaves, serrated blades and a multitude of flakes sufficient in quantity to be described as a *bushel*. Soon after, the varied appetites of collectors such as Edward Allen and Charles Monkman saw the hoard dispersed, individuals acquiring items according to their taste and interest. The vast majority of the flakes were not retained at all, simply added to the gravel ballast being laid down for the railway at the time.

Only a fraction of the original hoard has found its way to the Yorkshire Museum, but what there is suggests a date in the fourth millennium. This includes at least one axe blade of Cumbrian stone, most likely Group VI. It also includes several flint axes, among them a 'Seamer' form, distinguished by a well-rounded cutting edge, shallow concave sides and a broad butt. The form of the blade is distinctive enough, and comparable with others found across the region, including a hoard which gives the type its name. What is interesting here is its' condition. The blade has been flaked and ground to a fine finish, particularly on the cutting edge. But the overall surface has a smoothness and a sheen that marks it out. The body is heavily worn, the ridges of flake scars softened and subdued in a manner which suggests that the piece has been handled a great deal, far more than the other blades that have survived to be studied. The roots of this difference might be no older than the nineteenth century, a function of the attention that such a fine antiquity attracted. But the extent of the wear suggests otherwise, hinting that even in the Neolithic, this was a blade that was singled out, handled, handed round and on and down until the patina of that handling became a part of its biography. ■

●●● *It was the best thing we found all season, but typically, it came off the spoil heap. We must have missed it when we were de-turfing. That's why it's down as a 'topsoil' find – sounds better that way. ●*



The evolution of Neolithic and Chalcolithic woodworking tools and the intensification of human production: axes, adzes and chisels from the Southern Levant

Abstract

Flint axes, chisels and adzes were used in the Levant for approximately 6,000 years during the Neolithic and Chalcolithic Periods. These bifacial tools went through many technological and morphological changes during this long period. 2448 bifacial tools from 24 sites were systematically analyzed, covering the final EpiPaleolithic, Pre-Pottery Neolithic, Pottery Neolithic and Chalcolithic Periods. The results indicate that radical and sometimes rapid changes took place during this time, reflecting dynamic developments in architecture, economy, social organization and modification of the natural environment.

Bifacial tools have been associated with human activity since the start of the Neolithic. They provide clear evidence of a way of life, based on intensive exploitation of the environment, which changed the balance between Humanity and Nature, and point to the evolution of more complex forms of social structure. Bifacial tools continued to be used throughout the Chalcolithic, during which time the use of metals began, social and cultural complexity increased, and the first steps towards urbanization were taken. Differences within this group of bifacial tools suggest constant improvement in tool form and function and an intensification of both the production system and resource exploitation. These patterns point to the centrality of the axe and adze as working tools and as cultural symbols. Bifacial tools were perceived as tools of efficiency, a characteristic greatly admired during the Neolithic and Chalcolithic. Changes in the bifacial tool tradition are used in reconstructing the socio-economic systems that encouraged these rapid developments, leading towards a more effective use of natural resources and the intensification of human production.

Introduction and cultural background

The axe, adze and chisel were prominent among the bifacial flint tools of the Neolithic and Chalcolithic in the Levant (about 9,600 to 3,500 cal BC). The main purpose of the research reported in this paper, is to show how they provide evidence for social conditions at that time. To achieve this, patterns in the development of technology, in morphologies and in other characteristics of the industry are viewed in the context of broader cultural, economic and social changes.

Bifacial tools are shaped by intensive flaking on both principal faces, using a technique known in the Levant since the dawn of prehistoric times (for a detailed terminology see Barkai 2002; 2005:80). An *axe* is defined as bifacially shaped tool with a lenticular cross section. The working edge was formed by bifacial transverse flaking and polishing, and is wider than 2cm. An *adze* has a plano-convex cross section. The ventral face is mostly flat and the dorsal face is curved; the cross-section is trapezoid or triangular. Its working edge is wider than 2cm. A chisel is long and narrow with a variety of cross sections. Its cutting edge rarely exceeds 2cm in width.

Lower Paleolithic Hand-axes were prominent tools in the Levant for more than a million years. About 200,000 years ago, with the appearance of the Mousterian culture, flint knappers ceased to use the bifacial technique to shape their tools. Instead, this technique was used for shaping Levallois cores. Indeed, bifacial tools are hardly found within the flint industry of the Middle Paleolithic, the Upper Paleolithic, or the Epipaleolithic periods, that is, until about 13,000 years ago.

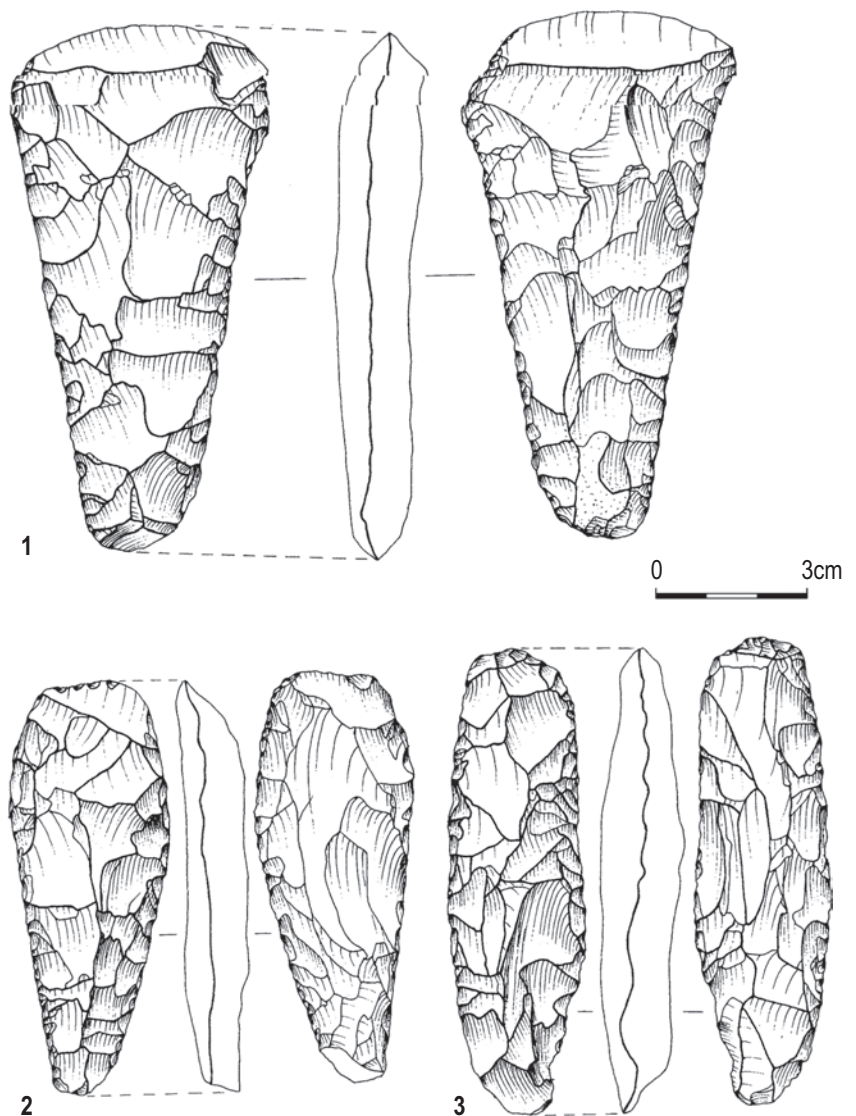
At the end of the Pleistocene, bifacial tools were manufactured once again, this time in the framework of the Natufian lithic tool-kit (13,000–9,600 cal BC, [dates for the Natufian and Pre-Pottery Neolithic (PPN) cultures are based on Goring-Morris and Belfer-Cohen 2008; dates for the Pottery Neolithic (PN) and the Chalcolithic periods are based on Banning 2007 and Gilead 2007]). This reappearance is just one comparatively small change at a time of major changes in society that occurred during the transition from mobile food collectors and hunters to agricultural sedentary communities (Bar-yosef 1998). Early signs of this transition include orderly architecture, new forms of symbolism, common burial customs and the emergence of social complexity – all of which appear for the first time in the Natufian, and

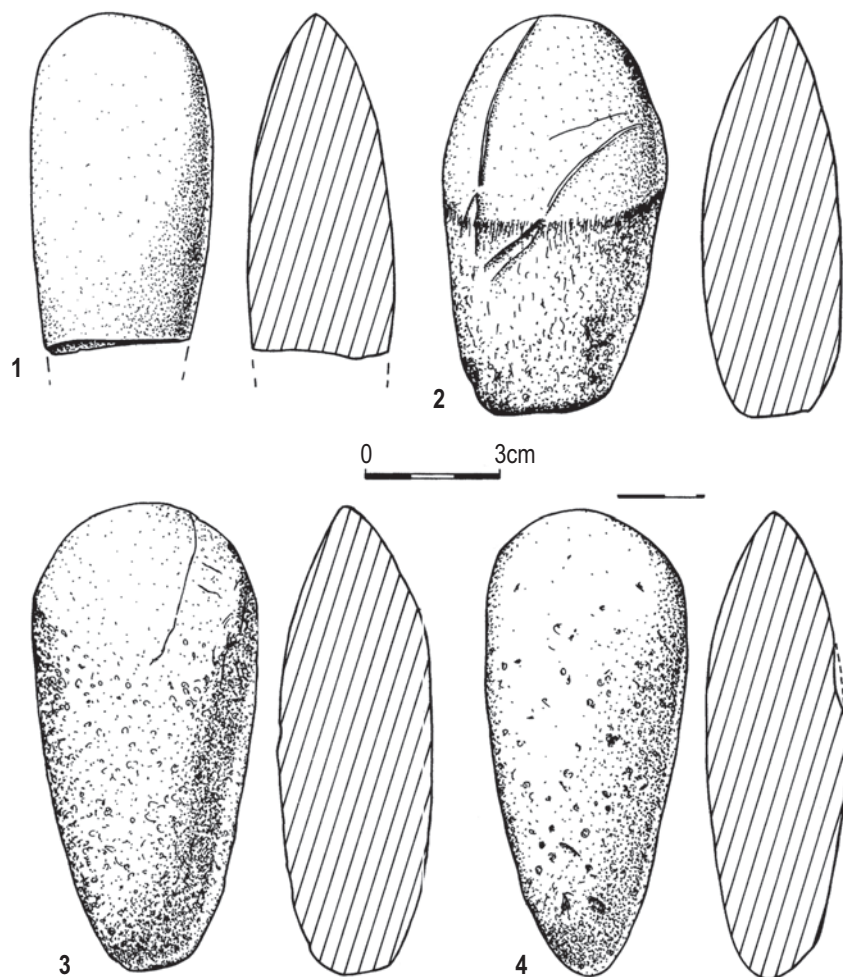
constitute the infrastructure of Neolithic societies.

The first sites large enough to be called *villages* are found during the first phase of the PPN period (hereafter PPNA), 9,600–8,500 cal BC. In these villages were found public buildings, such as the wall and tower of Jericho (Barkai & Liran 2008), items which suggest long-term commerce, possible cereal cultivation, artistic representations and unique burial customs. These permanent settlements, along with the introduction of plant cultivation, underlie the definition of the Neolithization process (Bar-Yosef 1995; Kuijt & Goring-Morris 2002), characterised by the introduction of the flaked flint axe, the working edge of which was shaped by transverse blows (Fig. 1). Along with flint axes, flint chisels and polished stone axes (made of basalt, limestone and other materials, Fig. 2) also begin to appear at around this time.

Fig. 1.

PPNA flint axes shaped by transversal blows from Netiv Hagdud.





significantly different in character. These differences can be seen in pottery, art, architecture and burial customs (Gopher 1995), and also in lithics, particularly in bifacial tools (Barkai & Gopher forthcoming; Gopher & Barkai forthcoming). The flint axes that appear at the beginning of this period are similar to those of the previous period. However, by the end of the PN period, axes are replaced by adzes.

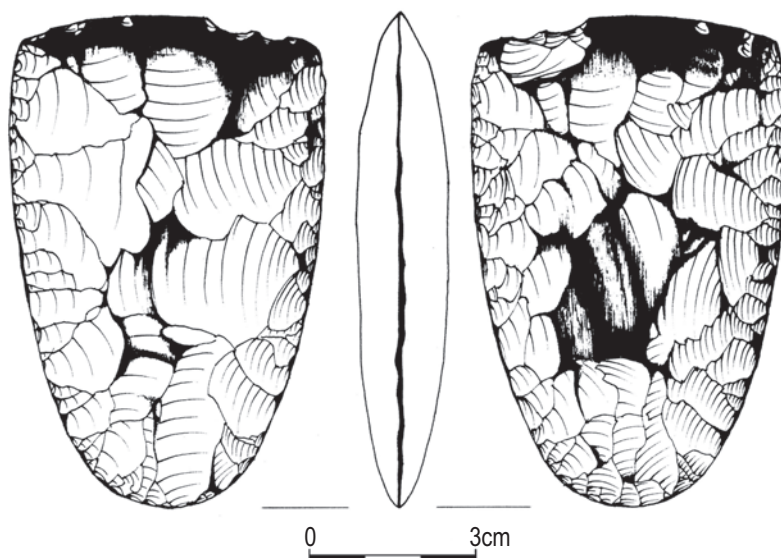
The adze became the dominant bifacial tool during the Chalcolithic, 4,500–3,500 cal BC (Fig. 5). This change in the dominant tool type, coincides with the “secondary products revolution”, when milk and dairy products began to appear in the economy of the larger, better organized settlements. The Chalcolithic also sees the production of a wide variety of pottery forms, as well as accessories used for burials and rituals (Levy 1995). Flint and bifacial tools disappeared altogether after the Chalcolithic and were replaced by metal tools.

Fig. 2.
PPNA polished stone
axes from Netiv Hagdud.

During the second phase of the PPN Period (hereafter PPNB, 8,500–6,400 cal BC), axes shaped by bifacial flaking and grinding/polishing (Figs. 3–4) replaced those shaped by transverse flaking. While stone and basalt axes are found infrequently, polished chisels and small axes, usually made of different lithologies, begin to appear. Domestication of cereals and livestock indicate the development of an agricultural system. There was also an increase in settlement sizes, with some extending over tens of hectares. Changes in burial customs, in rituals and art can also be seen, accompanied by an architectural preference for square buildings, all reflecting profound social and political developments (Bar-Yosef 1995; Kuijt & Goring-Morris 2002; Eshed *et al.* 2008).

Civilizations belonging to the Pottery Neolithic Period (PN, 6,500–4,500 cal BC), are characterized by the appearance of ceramics. During this period, economic structures based on agriculture and the domestication of livestock continued to develop. Several consecutive cultures may be identified during the PN (Yarmukian; Lodian and Wadi Raba), which are

Fig. 3.
PPNB polished flint axe
from Yiftahel.



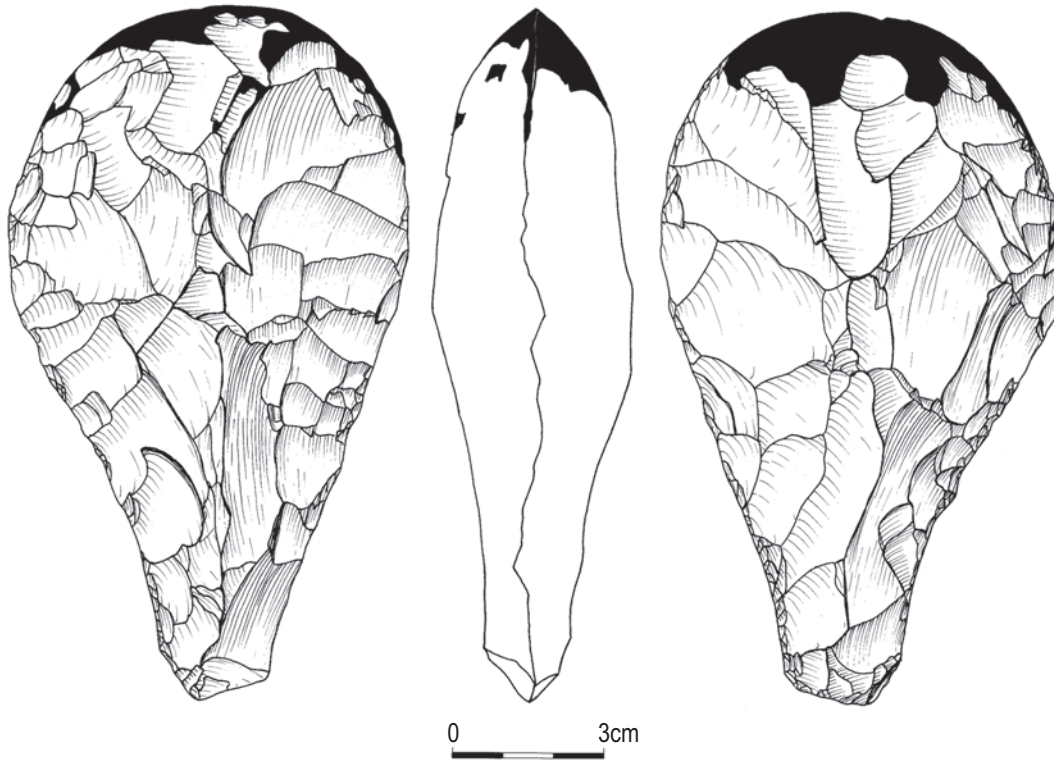


Fig. 4.
PPNB polished flint axe
from Beisamoun.

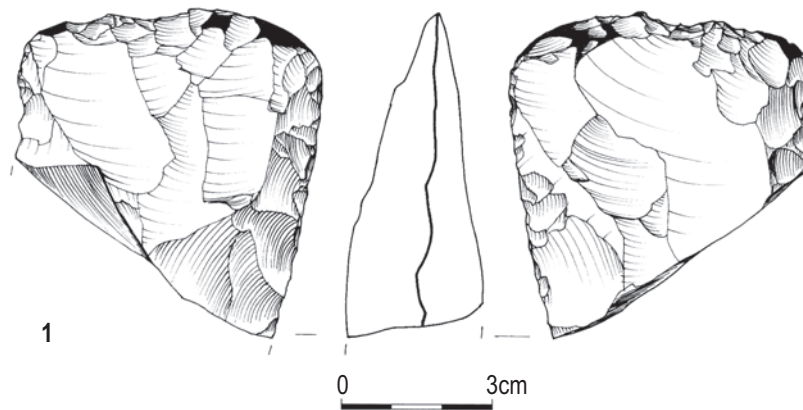
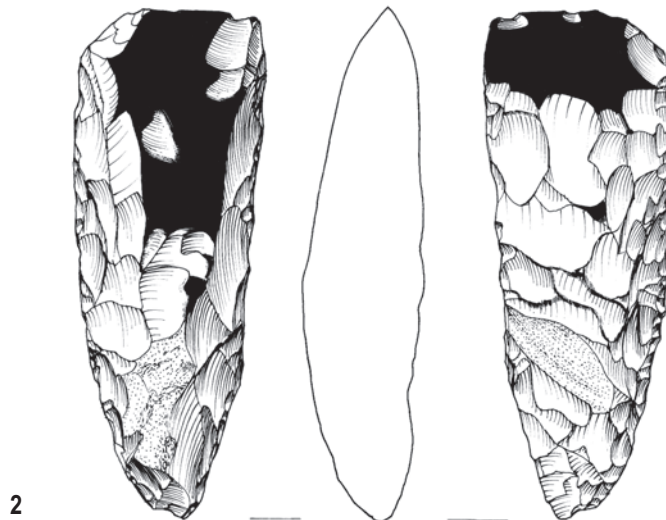


Fig. 5.
Chalcolithic polished
flint adzes from
Giveat Haoranim.



What were bifacial tools used for?

The similarities between Neolithic/Chalcolithic axes, adzes, and chisels and modern metal tools, suggests that they were used to perform tasks similar to those performed by their modern counterparts, that is, tree felling and woodworking. Using such evidence as time-on-task and muscle-use analysis, Peterson (1997) proposed significant changes in human development during the Holocene Period. For example, throwing and casting activities were well represented among the male Natufian skeletons, while females showed signs of grinding and crushing activities. Among Neolithic skeletons, Peterson also identified an increase in muscle pressure over the forearm, that is, the up-down movement. This increased activity may be related to agricultural work and tree felling (Peterson 1997). In her study of musculoskeletal stress markers in Levantine Natufian and Neolithic populations, Eshed also reported that physical stress had increased following the development of agriculture (Eshed *et al.* 2004). Many Natufian activities, such as hunting, gathering, woodworking and house construction, among other physical activities, continued into the Neolithic. However, some activities were completely new, such as tree felling and the building of mud-brick structures.

Use-wear analysis, ethnographic evidence and experimental archaeology strongly suggest that bifacial tools were used particularly for woodworking. Other suggested uses, including land clearance and cultivation, were not supported by use-wear analysis (Barkai & Yerkes 2007). Although used to process the same raw material, the three bifacial tool types – axes, adzes and chisels – had distinctly different uses. Moreover, it is clear that tools were deliberately created in different sizes according to the need of the time, task or place. Heavy labouring tasks were performed using large and heavy axes. For example, PPNB polished flint axes were used mainly for more difficult and heavier tasks, mainly tree felling and wood chopping (Yerkes & Barkai 2007; forthcoming). Very strong use-wear marks as well as numerous signs of damage appear on these axes, suggesting the heavy-duty nature of their use. Similar but lighter tasks were performed by using smaller axes (Haulder 1961:133; Harding & Young 1979:105). For example, the PPNA tranchet axes, shaped by transverse blows, were used for light and delicate woodworking, which did not leave pronounced use-wear marks and which caused very little damage to the tool. These tools were used mainly for clearing

undergrowth, scrub or small and thin trees (Yerkes *et al.* 2003).

Ethnographic evidence supports the use-wear analysis, showing the involvement of axes in a wide range of tasks (Pétrequin & Pétrequin 1993:361; Toth *et al.* 1992; Strathern 1969:315–319). A similar pattern can also be seen in Neolithic Scandinavia, where axes used for tree felling were also engaged in carpentry (Olafsson 1982:68–69). Among certain tribes in Papua New Guinea axes are also used to cut meat, sugar canes and bamboo (Strathern 1969:315–319; Pétrequin & Pétrequin 1993:361). Semenov (1976) showed that use-wear marks appear equally on both faces of an axe, but only on one face of an adze. Ethnographic evidence and use-wear analysis both indicate that adzes were more versatile tools than the axes. All tasks performed with an axe could be completed with an adze, although the latter was also suitable for additional tasks of a more delicate and lighter nature. A study of metal axes and adzes (Salaman 1975:23) further supports the view that the adze was used for more refined work than could be achieved by using an axe; these included the leveling, shaping or smoothing of wooden planks.

Semenov concluded that adzes were used mainly for woodworking. He rejected the suggestion that they were also used for land clearance and cultivation. Such work would have damaged the adze severely (Semenov 1976:124–125, 129–133). Ethnographical evidence supports Semenov's view. Similar to axes, adzes are used for tree felling, construction, shaping wooden utensils and bone processing. However, they were also used for more delicate tasks, such as carving and the manufacture of fibres and threads (Townsend 1969:200; Cranstone 1971:133; Toth *et al.* 1992; Pétrequin & Pétrequin 1993:361). Chisels, which are normally smaller than axes or adzes, were commonly used for more delicate woodworking, rather than heavy work (Becker 1962). Anthropological evidence suggests yet another, quite extraordinary, use of adzes. Graves associated with some Neolithic sites in Germany, contained skeletons whose skulls have been smashed. A study of the skull fracture patterns suggested that these skulls were smashed by use of stone adzes or other bifacial tools (Keefer 1993:108–109; Teschler-Nicola *et al.* 1996; Wind 1996). In sum, the Neolithic toolkit included different types of bifacial tools, of different size and weight, which were suited, amongst other things, to many different kinds of woodworking; from the most massive tasks to the most delicate ones.



Use-wear studies of bifacial tools from the southern Levant are scarce. Keeley examined two tranchet axes from Jericho and concluded these were hafted as adzes and used for working wood (Keeley 1983:759). Yerkes has examined samples from four sites belonging to the PPNA, PN and the Chalcolithic Periods. All of these use-wear analyses indicate that bifacial tools were typically used for woodworking, although some tools were also used to process bone, hide, meat, and plant material. These studies confirmed that chisels were used to complete lighter tasks than axes or adzes. Use-wear analysis also supports ethnographic evidence in that adzes were far more versatile tools than axes, demonstrated by the different extent and depth of use-wear marks found on the two tool types (Barkai & Yerkes 2007).

The dual role of bifacial tools as working tools and symbols

The connection between the (re-)appearance of bifacial tools and the transition from nomadic hunting and gathering to settled agriculture is not incidental. Bifacial tools were developed as a solution to a practical problem; they played an important role in the life of early settlers. The Neolithic axe was an essential and significant tool, used for most important daily activities. Typically, these included the clearance, construction and carpentry (Barkai & Yerkes 2007; Drobniewich 1988; Keeley 1983; Juel Jensen 1988; Olausson 1982; Yerkes *et al.* 2003; Yerkes & Barkai 2004; forthcoming). Since the axe was in essential and constant use, it had to change frequently, adjusting to new needs, construction methods and other changes (Pétrequin 1993: 52–3). Therefore, changes in the form and use of bifacial tools during the Neolithic and Chalcolithic most likely reflect wider material/cultural changes. The transition from temporary to permanent settlement is accompanied by the appearance of architecture which integrates timber beams and poles. The transition to agriculture required tree felling and the clearing of agricultural fields from previously forested areas. Domestication of livestock required animal pens and wooden fences. These tasks required the procurement and use of natural resources on a substantially greater scale than at any time previously.

Bifacial tools were much more than simply a solution to a technological problem. Beyond (and sometimes because of) their practical roles, they could also hold a profound social significance, drawn upon in the construction of ideas

about identity and in the negotiation of relationships (e.g. Steensberg 1980:4; Battaglia 1990:78, 133–4; Taçon 1991:204–205; Patton 1991a:67, 69; Pétrequin & Pétrequin 1993:368; Thomas & Tilley 1993:293, 309; Tilley 1996:322, 324). Implicated in the construction of ideas about age, gender and status, the Neolithic axe seems to have been a central cultural symbol, related to different spheres of human existence. In addition to its basic function, it had a value linked to the creation of relationships through both daily activities and special rituals (e.g. Tilley 1996:14).

There are echoes of these associations in ethnography. Among the Dani in Western Papua, for example, the axe is an essential part of existence. Agriculture is not sustainable without axes, and the axe is the central tool which enables the Dani to exploit nature. The axe has been used both as a working tool and as a ceremonial tool longer than any other (Pétrequin & Pétrequin 1993:359–361). Axes and similar tools have also attracted other meanings. In Melanesia, they are perceived as beneficial as they add grease to food. The axe is presumed to speed recovery and health, and a stone axe may be given to sick children in the belief that it will aid recovery. Some Melanesians consider the axe as the substance of life itself; representing the physical being of humans, and significant as a medium that transfers messages concerning reproduction. It is even called by a name which means “phallus” as well as “right hand”. Its blade represents the potential of Man’s reproduction, symbolizing the male reproduction energy. These connotations provide the axe not only with its spiritual value, but also its considerable economic value. Thus, symbolically, the axe is related to the production of new people and new artifacts (Battaglia 1990: 78, 133–4). Among Aborigines in Australia, axes symbolize masculinity and the coming of age. The symbolic meaning of the axe is related to the powers that shaped the landscape, so much so that the sources of the raw materials required to make them are often perceived as having a direct and powerful connection with specific ancestral spirits or dreamtime beings (Taçon 1991:194–5).

The characteristics of Neolithic and Chalcolithic bifacial tools

Important changes in the forms of axes, adzes, and chisels took place between the PPNA and the Chalcolithic. These changes can be studied in a number of ways, but a useful starting point

is the calculation of their *Frequency of Occurrence*. In order to calculate the overall frequency of occurrence for *all* bifacial tool types during each period (Barkai 2005:289), the frequency of occurrence for *each* of the three major bifacial tool types was calculated in relation to the total of bifacial tools from each site. Then, for each period and culture, the average frequency of occurrence and standard deviation statistics were calculated. Bifacial tools of the Natufian and Lodian (Jericho IX) Cultures were not included in this analysis, either because they are not directly comparable, or because of a lack of adequate sample assemblages. Each point in *Figure 6* represents the range and average value of the specified tool type. The vertical lines represent the standard deviation for each marked average. The continuous lines have no meaning other than to connect the averages for each tool.

While the PPN and the Chalcolithic Periods seem to be rather stable in their characteristic tool types, the PN seems to be a very dynamic period of change and transition. It is clear that a single type of bifacial tool was dominant at almost any specific time, accounting for a half to two thirds of all bifacial tools. Axes predominated in the PPN cultures but declined dramatically in relative frequency over the course of the PN period. This fall was matched by a rise in the proportion of adzes. During both the PPN and the early part of the PN, chisels show

a stable, though infrequent, profile among the bifacial tools. Over the course of the PN, however, and in particular during the period of the Wadi Raba Culture, they become far more frequent. The Chalcolithic is marked by the dominance of adzes, which comprised two thirds of the total number of bifacial tools, and the restoration in the relative importance of chisels.

These changing frequencies are valuable. But they only give us part of the picture, and are best set against broader patterns of tool making, tool use and symbolism as they unfolded between the Natufian and the Chalcolithic.

Natufian Bifacial Tools

Natufian bifacial tools lack uniformity, clear prototypes, or sufficiently clear diagnostic morphological features. The bifacial flaking technique was usually applied only partially, and was not even used to reduce the tools' volume. Most typically, their flaking is coarse and careless, and it is not possible to identify key variables in the quality in the manufacturing or shaping processes (Barkai 2005:367). Knowledge about the tasks performed using Natufian bifacial tools is scant. By their nature, such tools appear to have been designed to perform a different range for tasks when compared with the bifacial tools from later periods. Judged by their form and size, it seems that the Natufian bifacial tools were ill-suited for woodworking. While the functional purposes of the earliest bifacial tools remains unclear, it is probable that they had a symbolic role from the outset. For example, at Hayonim Cave, bifacial tools coated with ochre were hoarded in graves, and especially those of men (Belfer-Cohen 1988), indicating these tools had a ritual value.

PPNA Bifacial Tools

The PPNA marks the end of microlith-based industries and the rise to dominance of arrowheads, sickle blades and bifacial tools. These changes mirrored others. Axes shaped by transverse blows had a universal appeal to many societies at the start of the Neolithic, an appeal evidenced by their widespread and frequent occurrence. However, this did not last long, and they were quickly displaced by polished axes. It seems that the newly emerging Neolithic way of life brought with it new challenges that triggered a similar solution to similar problems world wide (Barkai 2005:12). The production of PPNA axes and chisels required access to essential good-quality materials, and the necessary skills to fashion them into effective tools. Such requirements led to the creation of axe

Fig. 6.
Relative frequencies of axes, adzes and chisels during the Neolithic and Chalcolithic periods.

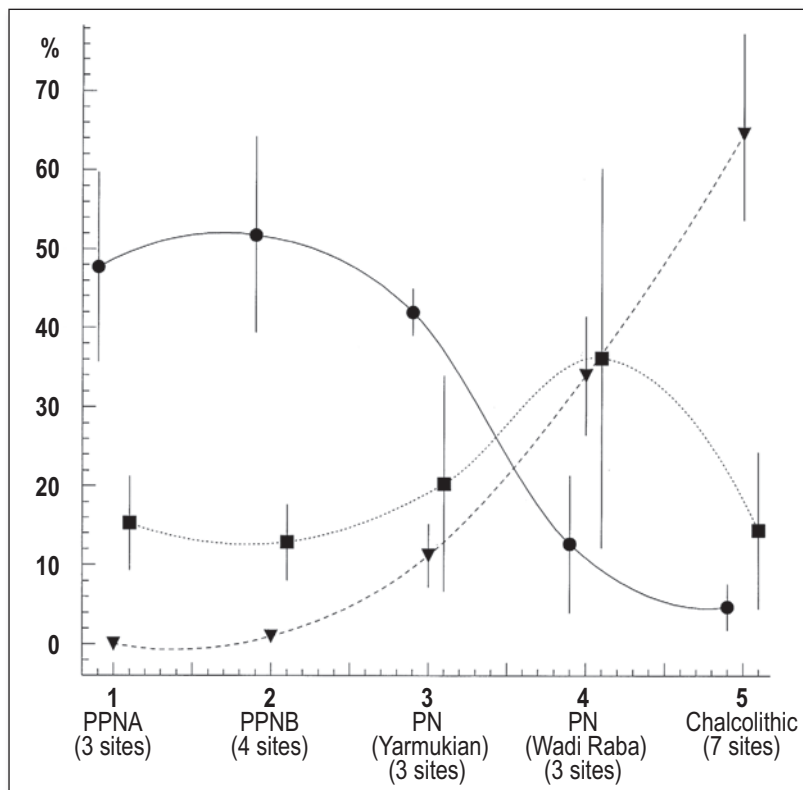
Legend:

- Axe
- Chisel
- ▼ Adze

Notes:

Average frequencies of each tool type were calculated from the total number of all bifacial tool types of each period.

The vertical line indicates the standard deviation of each periodical average.



workshops. These workshops were not only centres of manufacture, but also of distribution, repair and maintenance (Barkai 2001). However, manufacturing and maintenance activities were also carried out on a smaller scale within residential sites.

Flint axes shaped by transverse flaking are very light-weight, thin and narrow. Weighing on average less than 40gm each and with a typical thickness of 15mm, these small tools could not have been used for tasks requiring much force. In fact, their measurements, and the resulting possible tasks which they fulfilled, place these axes in a separate group when compared to the standard category of axes. It is probable that these less robust axes were used for cutting shrubbery or perhaps small trees, and for light woodworking tasks (Yerkes *et al.* 2003). Curiously enough, these small axes disappeared with the transition from circular structures (typical of the PPNA) to square structures as the dominant architectural form. No truly heavy duty tools, with which the environment could be remodeled, were found in the PPNA.

Polished stone axes were contemporaneous with the flint axes and chisels. These differ from flint tools in many ways, including raw material, quantity, shaping techniques, archeological context and state of preservation. Polished stone axes were often made from limestone and basalt, and were shaped by pecking and polishing. The matching of specific manufacturing techniques to particular lithologies and tool types was also possible. For example, no flint axes were polished; and no stone axes were shaped using transverse flaking techniques. While flint axes were used for daily tasks, polished stone axes appeared to have served a more symbolic purpose. They were made to be conspicuous: long, thick, and heavy (Yerkes *et al.* 2003). They are typically found whole and undamaged, unlike their flint counterparts. They are also found in special places or in otherwise formal or highly symbolic contexts. At Gilgal and Hatula for example, basalt tools were hoarded with a human figurine; at Netiv Hagdud, a polished stone axe was hafted for display rather than for use; at the Syrian site of Jerf El Ahmar, a basalt axe was found with three aurochs skulls in a burnt round house (Barkai 2005:369). Strangely, nothing is known of the source or manufacturing sites associated with these polished stone axes.

PPNB Bifacial Tools

PPNA customs continued into the early stages of the PPNB. Transverse flaked flint axes flint axes were still being manufactured (Khalaily *et*

al. 2007), but gradually, the practice of polishing spread to the larger examples made of flint and there was a decrease in the overall frequency of axes made of other stones. Polished limestone and basalt axes did however continue to feature in various forms of ritual activity. The overtly ritualistic use of axes also extended to a series of miniature items, which usually accompanied their larger counterparts throughout the PPNB. These tiny axes were typically made of flint or special minerals, and most are found whole and undamaged. They were probably used as talismans, symbols of status, or valuable personal possessions (e.g. Skeates 1995).

The PPNB polished flint axe is striking not only because of its relatively large size, but also for combining two previously unconnected features: polishing and flint. Extending the arguably ritualistic practice of polishing to evidently functional flint axes was highly significant. Polishing made flint axes stronger and more durable in use than their unpolished counterparts (Barkai 2005:18). Not only that, it brought out qualities in the form and appearance of axes which added to the esteem in which they were held. As noted above, it is also significant that these changes in approaches to stone happened at a time that saw shifts from the oval structures of the PPNA to the more rectangular buildings of the PPNB.

This new type of axe, the polished flint axe, became the dominant type among the PPNB bifacial tools. These were used for sustained heavy work such as tree felling (Barkai & Yerkes 2007). Of course, not all polished flint axes were large enough to perform these tasks; and it is likely that smaller examples replaced the more traditional uses performed previously by the more delicate transverse flaked axes. During the PPNB then, human control over the environment took on new characteristics, driven, in no small part, by the shift to new methods of building construction. The floors of PPNB rectangular structures were constructed using massive wooden posts, up to 60cm in diameter, set in equally massive post holes. At the site of 'Ain Ghazal, for example, rectangular single room structures covered areas of c.35–50m². It has been estimated that each house of this type used c.10 wooden posts to support the walls and ceiling (Rollefson 1997; Rollefson & Kohler-Rollefson 1989, 1990).

The PPNB saw some of the most profound changes associated with the Neolithic, among them an increased emphasis upon domesticated plants and animals and the dramatic modification of local environments. As the principal tools used in woodworking, bifacial



tools played a central role in this process. Woodworking was required in all areas of life; the construction of storage and living domains, the building of pens and other enclosures. Wood was also a fuel in the manufacture of lime plaster, which had many uses during the PPNB; covering floors, walls and graves, the plastering of skulls, and the preparation of sculpture and beads. Wood reserves were exploited extensively during the PPNB, in some cases perhaps to the point of exhaustion. By the final stages of the PPNB (the PPNC) architectonic trends suggest that this may have been a concern. Wooden posts gradually disappeared, or were reduced in diameter (Rollefson 1997:288–303; Rollefson & Kohler-Rollefson 1989:81). Plaster also declined as a widely used material. Instead, walls were used to support structures, and mud floors became more popular.

The PPNB saw the production of a new type of axe, stronger and more durable, which was capable of meeting new construction requirements. Undoubtedly, use of wood reached new levels during the PPNB. The increase in scale was dramatic, so much so that it may have brought about an environmental crisis that led to an alteration of global climate (Ruddiman 2003, 2005; Ruddiman *et al.* 2008). Even if such a crisis did not happen, the relationship between Humanity and the Environment was certainly redefined at this time. Communities were modifying their natural environments in ways that could not be ignored. And it was in this pursuit of power, economic prosperity, and social development, that bifacial tools played such important roles – as both functional tools and as symbols.

PN Yarmukian Bifacial Tools

The start of the earliest culture of the PN, the Yarmukian culture, was marked by the appearance of a new tool type: the adze. A few adzes have been recognized from the PPNB, but within the Yarmukian toolkit, adzes became much more common, typically accounting for c.10% of all bifacial tools. As during the PPN, axes and chisels continued to dominate the group, but the axe's supremacy was now challenged by the chisel. Early in the PN, chisels comprised c.15% of all bifacial tools, reducing the overall proportion of axes from almost total to around 40%. The acceptance of the chisel as a third bifacial tool type, marked the start of a decline in the central importance of the axe, which eventually led to the adze becoming the dominant bifacial tool.

Whatever its causes, the decline in the need for heavy woodworking and tree felling, saw

axes give way to more versatile adzes. These were used in similar ways to axes and, despite a tendency to be lighter and more narrow, broadly resembled them in size and weight (Barkai 2005:293–335). The manufacturing and shaping processes of both axes and adzes were similar, with the exception of blank selection. Thus, the adze could have easily found its way into the existing familiar system. However, adzes and axes differed in their hafting methods. This was significant because it affected not only the length and cross section of the tools, but also, and perhaps more importantly, methods of use. The adze, hafted like a hoe, was adequate for far more tasks than the axe. Adzes were used for anything from felling massive trees to chopping to the preparation of wooden utensils (Barkai & Yerkes 2007). The axe, in contrast, was inadequate for such delicate tasks. Looked at in long term perspective, it seems almost as if the adze was “on probation” during the Yarmukian culture. Until it had proved its worth, its supremacy could not be accepted, and therefore, the transition from axe and chisel, to adze, was gradual.

Although PN architectural trends turned away from the use of wood as the primary construction material, it was still used for roofing, and probably also for pens and other enclosures. Wood was no longer used as fuel for plaster making, but did see use in this way in the emerging pottery industry. The appearance of ceramics was the most significant cultural change of the period, and underlies the definitions of PPN and PN cultures. This significant change is also evident in the new trends found among the bifacial tools. It could be that the use of stone tools for cutting wood as fuel for plaster manufacture differed significantly from the cutting of wood designated for use as a fuel for firing pottery. Perhaps the versatility of adzes was better suited to the firing of pottery. Or perhaps, this new tool was adopted by the growing pottery industry as a new symbol for a new way of life. Whichever the case, the relationship between the adze and the pottery industry becomes stronger over time, as both the dominance of the adze, and the pottery industry characterise the Chalcolithic.

PN Lodian Bifacial Tools

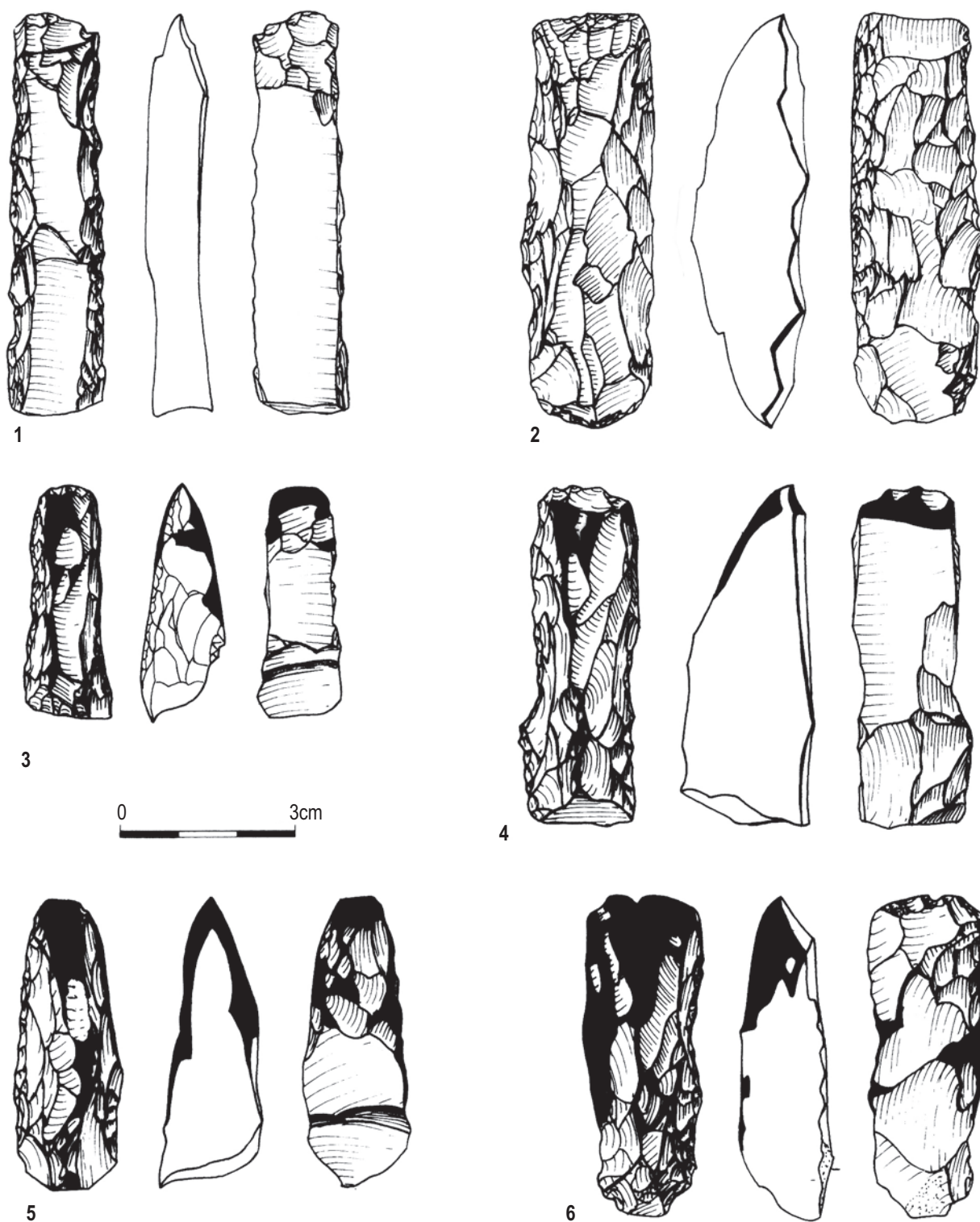
No Lodian assemblages were analyzed during this study due to the scarcity of bifacial tools in any of these assemblages. However, with the recent publication of two Lodian flint assemblages (Gopher & Blockman 2004; Kahlailly 1999), it seems that bifacial tools were not used excessively in the Lodian culture. The Lodian



culture did not make much use of wood as fuel for its pottery industry. Lodian pottery used bright clay, hay, and organic tempers. The tools were made by hand, not on a potters' wheel, and the firing was done in low temperatures (Gopher & Blockman 2004; Gopher & Gophna 1993). It is possible, then, that the decreased demand for wood caused, in turn, a decrease in demand for bifacial tools.

Lodian bifacial tools were not the only flint tools that portray unusual characteristics. The Lodian culture ceased to use both the naviform technology for the production of blades and the large arrowheads that had been common up to this point. The Lodian culture also saw new technologies, among them the making of sickles from a variety of blanks via pressure flaking (Gopher & Gophna 1993). These changes,

Fig. 7.
Pottery Neolithic
(Wadi Raba)
flint Chisels from
Nahal Zehora I.



which are significant, may represent changes in daily routines or in their execution, for example: harvesting, hunting, and woodworking. The changing blades and sickle blades may indicate new harvesting methods or less intensive harvesting; the disappearance of large arrowheads may be related to the growing reliance on domesticated animals and the gradual secession of hunting.

PN Wadi Raba Bifacial Tools

The transition from axe to adze reached a climax during the Wadi Raba culture, which saw the axe reduced to only about 10% of all bifacial tools. Both adzes and chisels reached a level of popularity previously unknown, each constituting about one third of all bifacial tools. The chisel remained the most stable form throughout the PN (Fig. 7). That said, some morphological changes can be detected, which suggest a close practical and perhaps conceptual link with adzes. While Yarmukian chisels and their predecessors have lenticular lengths and cross sections, as do axes, Wadi Raba chisels more closely resemble adzes, with their plano-convex length and cross sections. As this characteristic is pertinent to the hafting of the tool, it seems that chisels were adapted to the trends of the time. Demand for heavy woodworking tools continued to decline during the Wadi Raba culture, and adzes were used more frequently for lighter work, as were chisels (Yerkes & Barkai forthcoming). These changes also happened alongside others; in the composition of flint and ceramic assemblages and in architectural traditions. Flint sickles become rectangular and more finely denticulated, and arrowheads seem to disappear altogether, changes which suggest a final, significant, decline in the economic and social importance of hunting.

The decline of hunting as a primary economic factor heralded a new order, based on new and increasingly consolidated means of production. As part of this change, it seems that gender relations were also affected, determining new labour relations, and perhaps defining gender-specific roles and responsibilities (Naveh & Gopher forthcoming). Changes occurring throughout the PN were closely related to the economic transition to a system based entirely on agriculture. These changes encompassed all areas of life, including the introduction of new manufacturing techniques, and a new social order. The institutionalization of the means of production and reproduction were essential to ensure the survival and continuation of societies. Throughout this process, bifacial tools provide a barometer of change.

Chalcolithic Bifacial Tools

The adze was the dominant bifacial tool during the Chalcolithic. Chisels also continued in use, but by this time, axes had almost entirely disappeared. The increasing demand for adzes also brought about changes in the choice of raw material, involving decreases in both the quality and suitability of the rocks used, a trend that went hand in hand with the increasing use of locally available materials. Certainly, such a change affected the whole industrial system established as early as the PPNA. With the falling away of traditions of mining or quarrying at specific sources and the increased reliance on material procured with little effort or formality, manufacturing became a feature of life on many settlements. This, in turn, brought about changes in performance. The reduction in quality of the rock used to make most adzes meant that they broke far more frequently, a tendency evidenced in many Chalcolithic assemblages.

The dual role of the axe, as functional tool and cultural symbol, was now transferred to the adze, which became an important cultural marker at this time. Whole undamaged polished adzes were placed with some formality in magnificent burial complexes, such as Peqi'in Cave, clear evidence that they had taken on a role as important markers of standing. The Chalcolithic also saw other shifts of practice, amongst them a falling away of the traditional distinction between adzes that were used and those that played an essentially symbolic role. It was context that determined the significance of an adze, and it may well be that associations, with people or tasks, acquired during use, may have increasingly been a part of that significance at this time. There are also hints that adzes were sometimes reworked as part of the process of according them symbolic significance. At Peqi'in for example, parts of the polished surface of certain adzes were deliberately removed prior to their incorporation in formal deposits (Barkai 2005:268).

During the Chalcolithic, adzes were extensively used for woodworking. However, as bifacial stone tools from only a single Chalcolithic site were analyzed for use-wear marks (Yerkes & Barkai 2004), it is possible (although unlikely) that these tools, hafted as hoes, were also used in a similar way to cultivate the land. If indeed any adze was used for agricultural purposes, it must have most certainly been damaged to an extent that could no longer function as a woodworking tool. Thus, adzes deemed unfit for woodworking were most likely used as hoes, and this would have certainly been the last stage in their life cycle.

Still important for woodworking, in the provision of fuel for pottery production and in various kinds of construction, adzes were most likely also engaged in new tasks that emerged during the Chalcolithic. These included work around the management of new resources, such as fruit trees (mainly dates and olives), and perhaps even the processing of secondary products. Fuel was also needed to fire the working of copper and gold, which became increasingly important over the course of the period. These broader economic changes hint at an intensification and diversification of production, which seems to have gone hand in hand with other developments, such as the emergence of settlement hierarchies and the appearance of formal cemeteries outside residential areas. These changes suggest that the period saw the emergence of Chiefdoms – complex hierarchies sustained by control over various kinds of production, and over the circulation of important materials, among them metalwork. The metal industries changed social and economic values and priorities and from the very first, copper axes, adzes, and chisels appeared both as working tools and as ritualistic objects. However, bifacial stone tools continued to hold their value as both practical and symbolic items throughout much of the period.

Despite occasional attempts at replacement by metal artefacts, bifacial stone tools continued to hold their value as both practical and symbolic items throughout much of the Chalcolithic (Shalev 1992). Various factors may have influenced this situation, among them the scarcity of the technical knowledge and/or resources need to produce metal tools (e.g. Goren 2008). By the end of the period however, the situation had changed, the use of stone adzes, chisels and axes effectively ceased. This abrupt end to long standing traditions is perhaps surprising given the continued importance of tasks such as woodworking in people's lives. But it is probably the result of developments in both the practical and symbolic importance of metal artefacts. Metal processing technologies and standards continued to develop during the course of the Early Bronze Age, as the manufacture and use of metal tools spread into new areas (Shalev 1992). Over time, these metal tools proved to be much more efficient than their flint counterparts, and were more highly valued. Beyond questions of access and the appearance of materials, metal artefacts were easier to maintain, repair and recycle, the latter potential creating the possibility that they are under-represented in the record that we have.

Discussion and conclusions

The procurement, use and deposition of stone and flint bifacial tools were central to the transition from hunting and gathering to agriculture, sedentary settlements, and to the social complexity which characterized the Neolithization process in the Southern Levant. They emerged in response to new needs, which were themselves related to important social, cultural and economic transitions at the time. As well as their function, they also linked symbolic elements with social situations, giving them new values as perceptions and belief systems developed. On the one hand, they were essential for the massive and intensive environmental exploitation that took place, especially during the Neolithic. That is at least part of the reason why their use lives were often prolonged, individual tools resharpened, repaired and reworked over considerable periods of time (Barkai 1999). Many axes and adzes, that were no longer functional or repairable, were converted to cores, thus allowing continuing use of the raw material in new ways. On the other hand, these tools were also caught up in the playing out of social relations and in the struggle for power and renown in society. They were both production and reproduction. Archaeologically, the materials we recover sometimes speak more directly to questions of use and practicality, sometimes to issues of symbolism and ceremony. I have argued here that one of the important qualities possessed by many bifacial tools at this time was a categoric and symbolic association with maleness (see also Barkai 2005:68–70). This was sufficiently powerful that axes created a symbolic link between human fertility and the fertility of the land. Undoubtedly, with such significance, the axe was a prominent feature in socio-political discourse.

The practical and symbolic value of these tools was implicated in all aspects of their lives; from quarries and workshops to their placement in hoards and burials. Great efforts – translated, in modern terms, into high manufacturing costs – were invested in the procurement of such materials (Barkai 2005:6–9; Barkai *et al.* 2007). This alone suggests the perceived importance of these tools to their owners and to broader society. The location of stone and flint quarries and mines, typically at a distance from the occupation sites, points to a deliberate distribution system, and perhaps even to a complex exchange system, capable of explaining the movement of the raw materials and the finished products to their final destinations (Quintero 1996; Quintero & Wilke 1995; Schyle



2007). These mines and quarries, along with certain workshops, were situated in conspicuous locations and became “scars” in the otherwise undisturbed landscape; used repeatedly by different generations.

Although axes, adzes and chisels were used to process wood, it is clear that each tool type had its specific functional purposes. Tranchet axes were used for light tasks but never for tree felling (Yerkes *et al.* 2003), tasks more often addressed with later Neolithic flint polished axes. However, axes were themselves only used in a certain number of activities. Adzes, in contrast, were much more versatile, capable of being deployed in a far wider range of tasks, including those delicate forms of working that also suited chisels. Their versatility may have been part of the reason they became so ubiquitous (Yerkes & Barkai 2004; 2007; forthcoming).

The manufacture of PPNA axes was an innovation which required a new flaking technology. It also involved the development of an entire system, including workshops for manufacturing and repair, which became part of each tool's biography. Polished stone and basalt axes, which appeared for the first time in the PPNA, were also important cultural markers. Although polishing was a well-known technique, never before had it been applied to stone artefacts. These stone axes differ considerably from their flaked flint counterparts. Their large size, combined with the use of special raw materials and their polished appearance, gave them ritualistic and symbolic value. PPNA bifacial tools are the first group of tools to overtly fulfill two roles: functional and symbolic. Functional analysis of PPNA bifacial tools shows that this was only the beginning of a trend. Although humans were still learning how to modify their natural environment, the consequences of bifacial stone tools were apparent, and were embodiments of the respect, and possibly awe and wonder, given to the tools by their makers and owners.

The transition from PPNA to PPNB was marked by a gradual change in the way in which bifacial tools were made, used and perceived; there was a phase during which old techniques and new ones co-existed, while the one declined and the other matured. The most conspicuous change of the time was the extension of the polishing technique from overtly symbolic tools to those that saw sustained practical use. Polished PPNB axes are considerably larger, heavier and more efficient than the transverse flaked PPNA axes and it has been argued here that these practical characteristics;

mass and efficiency, mattered a great deal at the time. The effectiveness of the PPNB axe helped to take the relationship between humans and the environment to a new level.

By the PN, the axe had become a most powerful functional and symbolic item in southern Levant culture. Its replacement by a more efficient tool, the adze, was a long and gradual one; a change that could only occur within a broader and more comprehensive process of cultural change. At the beginning of the PN, a new need had arisen: wood as fuel for the growing pottery industry. This need, along with the development of architecture, may have stimulated the production of adzes. All PN assemblages suggest a gradual transition, from the old familiar axe to the new adze, which was complete by the Chalcolithic. The adze was developed as part of an ongoing process of socio-economic and cultural change which, during the PN, had shifted towards a full dependency on agriculture and the domestication of livestock. Such an economy demanded a new social order, which, consequently, created political struggles and debates. It is no surprise, then, that the early PN's symbolic assemblage is such a rich and varied one (e.g. Gopher 1995). At first glance, the development of the adze may seem like only a relatively minor change. In skilled hands, however, its versatility gave it a potential that earlier axes never realized, a potential that also encouraged its recognition as an important symbol.

Just as earlier axes had done, the adze persisted as an important tool and as a symbol for some time before those roles were finally taken on by metalwork and metalworking. These sequences of development were driven by many things. But ultimately, the need for resources and even the investment of time and effort in the making of axes and adzes was a consequence of the wealth economy. As the primary working instruments and as symbols deployed in exchange and display, they were intimately bound up in the complex and dynamic social systems of the Neolithic and Chalcolithic in Southern Levant.

In order to create and implement technological change, certain pre-conditions are necessary. These conditions are found typically when a social system is willing to accept innovations; to change the familiar for the unfamiliar. Typically, the adoption of such change also depends on effective social and political relationships. Thus, the technological changes that bifacial tools underwent suggest an open-mindedness in the Neolithic and Chalcolithic societies of Southern Levant. These societies



acknowledged that the new needs to be met because of their changing lifestyles, required a technological system that was continually and successfully responsive. These societies appeared to have been highly manipulative; capable of training their members to achieve specific community-focused goals; and creating ideological identities.

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Eclogite or jadeitite:

The two colours involved in the transfer of alpine axeheads in western Europe

Abstract

During the 5th and 4th millennia BC, the Neolithic extraction of stone around Mont Viso and in the Mont Beigua massif in the north Italian Alps resulted in the production of large polished axeheads in eclogite, omphacitite, jadeitite and amphibolite – raw materials which were not only rare but which also have remarkable mechanical and aesthetic properties. These axeheads circulated around western Europe over great distances and in particular, between the Alps, the Atlantic and the North Sea.

Among these Alpine jades, research suggests a tendency for different raw materials to be represented in different geographic areas. Axeheads and other items made from dark-coloured rocks from the family of eclogites and omphacitites tend to predominate in north Italy and southern France. By contrast, light-coloured and often translucent rocks of the jadeitite family predominate in the Paris Basin, in Germany and in Great Britain and Ireland.

This paper documents the manufacture, circulation and deposition of different types of Alpine axeheads over time. More specifically, it discusses observed trends in relation to variability in the supply of raw materials and finished objects, the nature of regional traditions and long-distance transfer, and ultimately, the changing significance of axeheads as socially valorized artefacts.

Introduction

During the 5th and 4th millennia BC, the Neolithic extraction of stone around Mont Viso and in the Mont Beigua massif in the Italian Alps resulted in the production of large polished axeheads in eclogite, omphacitite, jadeitite and amphibolite – raw materials which were not only rare but which also have remarkable mechanical and aesthetic properties. These axeheads circulated around western Europe over distances up to 1700 kilometres as the crow flies, and in particular between the Alps, the Atlantic and the North Sea. This phenomenon involved not only Alpine jades (a term which will be used to cover the various rock types listed above) but also variscite and fibrolite from Spain: groups of artefacts made of all three materials have been found within the giant tumuli of the Carnac region. There can be little doubt that this phenomenon corresponds to the contemporary Chalcolithic production of objects of copper and gold in east-central Europe.

Among these Alpine jades, the authors have recognised the presence of different raw materials in different areas. Axeheads and other items made from dark-coloured rocks from the family of eclogites and omphacitites tend to predominate in north Italy and southern France, while light-coloured and often translucent rocks of the jadeitite family predominate in the Paris Basin, in Germany and in Great Britain and Ireland. We shall analyse the manufacture, circulation and deposition of Alpine axeheads in terms of the chronological evolution of individual axehead types; variability in the supply of raw materials and finished objects; the choice of axehead types in the process of long-distance transfer; and finally by interpreting axeheads as socially valorised artefacts.

When Alpine axeheads first started to circulate in a westerly direction, from the end of the 6th millennium, the people who manufactured utilitarian workaday axeheads of Alpine rock used a variety of stone types, mostly eclogites and amphibolites. The use of jadeitite and omphacitite seems to be limited to the production of small and particularly hard tranchet axeheads and stone rings. This episode of production is contemporary with the Early Neolithic cultures in the southern Piedmont, with the Cardial and with the Villeneuve-Saint-Germain (VSG) Culture. During the first half of the 5th millennium the use of eclogite, omphacitite and amphibolite continued to predominate; at the same time we see the emer-

gence of remarkably large adze-heads, reaching a length of 35 cm in the case of the Bégude type. The people who produced these axe- and adze-heads can be identified as the inhabitants of the arc-shaped area around the foot of the Alps in Italy, and also communities on the French side of the Alps. In Italy, there are clear links with the Square-Mouthed-Pottery (*Vases à Bouches Carrées*, VBQ) Culture, while in France the identity of the producing groups is harder to discern; they may belong to a pre-Saint-Uze Cardial tradition.

Shortly before the middle of the 5th millennium, there was a complete inversion in the criteria used for the choice of raw material. From this point, jadeitite dominates archaeological finds to the west of the Alps as far as the Gulf of Morbihan, being used for up to 95% of all the axeheads. In contrast, northern Italy – and especially the plain of the river Po – seems to have been excluded from the transfer of large jadeitite axeheads which extended elsewhere to the maritime fringes of Europe, reaching Britain, Ireland and Germany just before or around the end of the 5th millennium. The Piemontese axehead producers, with their hands-on access to the source areas of the jades, seem to have privileged the transalpine diffusion of axeheads in a north-westerly direction, well before the Saint-Uze and the Chasséen Cultures. In the course of these transfers from Italy to Brittany, certain kinds of axeheads would be selected – the large, thin Durrington type and the Puymiro type – and then, at a distance of 500 kilometres from the source areas, some of these would be re-polished to change their shape to that of the Altenstadt-Greenlaw type. When the axeheads arrived in the Gulf of Morbihan, 1000 kilometres away from the source areas, a good number would then be repolished a second time, to produce axeheads of the Tumiatic and Carnac types.

Such activities directly inform the social interpretation of the large axeheads of Alpine jades in Western Europe (excepting parts of northern Italy, where other rituals and other socially valorised objects seem to have been in use). In the symbol-system in use during the Middle Neolithic to the west of the Alps, certain jade axeheads would be diverted from their primary function as tools for felling trees and working wood and treated instead as sacred objects, to be deposited at certain specific points in the landscape or in the tombs of exceptional individuals, as in the Carnac region. The immense importance of these axeheads in religious rituals is amply demonstrated here and elsewhere on the southern coast of Brittany,



where representations of axes figure, along with other ritual-related signs, on massive stelae. Furthermore, certain of the Alpine axeheads that had been repolished in the Morbihan, the so-called 'Carnac'-style axeheads, were re-injected into the circulation system, to travel towards north-west Iberia, Germany, the Alps, Italy and Croatia, in some cases travelling as far as 2500 kilometres (in the case of the axeheads found in Croatia and southern Italy, for example). These 'returning' Alpine axeheads of Carnac type would have been accorded exceptional social value, and along the routes travelled, one finds imitations made in locally-available rocks. This re-diffusion would appear to have been accompanied by a spread of religious and ritual concepts that originated in the Morbihan and which gave rise to the large, shaped and decorated stelae that occur in the Auvergne, in Burgundy, in western Switzerland and in Valais, close to the heart of the Alps.

History of research

The petrography of the thousands of Alpine rock axeheads that circulated across Western Europe from the end of the 6th millennium BC to the mid-3rd millennium BC, was first studied by Alexis Damour in 1865. It was his analysis of axeheads that defined the use of the mineral jadeite, and identified a probable source in the Mont Viso massif, 70 kilometres south-west of Turin (Damour 1881). These Neolithic axeheads in fine-grained rare rocks that are particularly dense, tough and resistant, are hard to work, and that take a long time to saw and polish, demonstrate remarkable mechanical and aesthetic properties. It is not surprising that elsewhere in the world, in the highly stratified societies of ancient China and Mesoamerica where nephrite-jades and jadeitite-jades have been used, they have been associated with religious and temporal power, and with the notion of immortality.

In western Europe, the origin of eclogite, omphacite and jadeitite in the Italian Alps was soon confirmed by the work of Giovanni Battista Traverso (1898, 1901, 1909) on axehead roughouts from the region of Alba (Cuneo, Piedmont, Italy), and by that of the geologist Secondo Franchi (1904). It was Franchi who identified potential source areas at the foot of Mont Viso and, in particular, the omphacites and jadeitites of the the Bulè Valley, and in the massif of Mont Beigua, to the north-west of Genoa. It was quickly realised that the axeheads made of these materials had a special status:

often translucent, catching the light of the sun, these magnificent polished objects, large and small, circulated in Europe over considerable distances. By 1878 Damour and Leopold Heinrich Fischer had recognised examples in Brittany, a thousand kilometres from the potential source areas, and Denmark, 1200 kilometres away (Fischer 1880; Meyer 1882). The idea that these Neolithic Alpine axeheads had held an exceptional value and social significance was confirmed by these long distance movements, which echoed those of Guatemalan and Chinese jades. The geographical distribution of axeheads made of less prestigious stone, by contrast, rarely extended beyond the regional in scale, travelling only 200–250 kilometres as the crow flies (Pétrequin *et al.* 1995).

Thus, it appears that all the elements of the research into Alpine axeheads were already in place at the dawn of the 20th century. But to progress matters further, what was needed was fine-grained chronological information, typologies of axehead development and examination of the cultural context of the findspot: these were not attempted until the 1970s. In the meantime, the idea that axeheads could have come from the Alpine interior was virtually abandoned by prehistorians, despite the fact that axeheads were often being discovered there as isolated finds. The interest in Alpine axeheads was coming from geologists and petrographers, who were applying sophisticated techniques of analysis. The initial thrust of this work was an exemplary study by William Campbell Smith of the Alpine axeheads of Britain and Ireland (Campbell Smith 1963, 1965, 1972), followed by the work by Valerie Jones *et al.* (1977) and Alan Woolley *et al.* (1979). The techniques of determination through petrological thin sectioning, X-ray diffraction, specific density and microprobe analysis were subsequently adopted on the Continent, with the work of Pierre-Roland Giot (1965) in Brittany, of Charles-Tanguy Le Roux *et al.* (1974, 1980) in the Loire Valley, of Monique Ricq-de Bouard (1996) in the Midi of France and of Claudio D'Amico *et al.* (1995, 1997, 2000a and b, 2003, 2006) in north Italy.

All these archaeometric approaches led to the improved mineralogical and petrographical characterisation of various Alpine jades. They also revealed the immense geographical extent of the distribution of these precious axeheads across western Europe, as far as the Low Countries (Schut *et al.* 1987), Catalonia (Ricq-de Bouard 1996), southern Italy (Leighton & Dixon 1992), Austria (Prichystal & Trnka 2001), Croatia (Petric 1995) and Slovakia (Spisiack *et*



al. 2005; Hovorka *et al.* 2008). However, with the adoption of these sophisticated and highly specialised analytical techniques, it would appear that the researchers rather lost sight of the archaeological questions. With most studies, the chronological factor was neglected, despite the fact that the phenomenon of Alpine axehead use spanned an estimated 2000 years. It is as though the social, cultural and technical evolution of Neolithic societies was regarded as negligible, and it was generally assumed (except with the work of Ricq-de Bouard, 1996) that any such evolution was gradual. Research on raw material sources in the Alpine interior was completely neglected. It seems as though it was assumed that fine-grained eclogites, massive omphacitites and large blocks of jadeitite were to be found in all the torrent-beds and all the moraines across the Alpine arc from the Val d'Aosta in the north to Mont Beigua in the south-east. The published maps of geological prospections that feature in the petrographic studies of axeheads certainly imply that this was the case (Compagnoni *et al.* 1995; Fedele 1999; Ricq-de Bouard 1996; Ricq-de Bouard *et al.* 1990).

These strictly petrographic studies, undertaken outside the context of archaeological concerns, naturally led to an extremely simple (and western-orientated) interpretation: Neolithic people would have selected thin, flattish cobbles from among the moraines and torrent beds leading down from the high Alps, where Alpine jades would be well represented. After a rapid initial roughing-out using a hard hammer, these cobbles would be pecked and polished, in order to feed into the down-the-line exchanges emanating from the Piedmont. Certain of these axeheads, the long and remarkably polished specimens, would have been regarded as prestige goods, as 'ceremonial' axeheads. Equally, according to this view, the especially high incidence of jadeitite axeheads in certain regions of Europe, and the similar preponderance of axeheads made from eclogites and omphacitites in other parts of Europe, reflected 'cultural choices' (D'Amico *et al.* 2003). This term lacks heuristic value and explains nothing because it fails to take into account the historical trajectories of the societies in question. (Regarding technical choice and cultural choice with regard to axeheads, see Lemonnier 1986; Pétrequin 1993a; and Pétrequin *et al.* 2006a.)

Finally, these interpretations were generally accepted by the scientific community which had delegated all responsibility for axehead studies to specialist petrologists. The remark-

able exhibition, organised in 1996 at the Museum of Turin, and its fine accompanying volume *The Ways of Green Rocks* (Venturino Gambari 1996), constitutes the culmination of this phenomenon. It would now appear that the principal point of interest in this monograph was its bringing together of a large number of roughouts and polished axeheads from north Italy, many of which had not been published before or were dispersed in small articles that are hard to access in libraries. It seems that the results of petrographic approaches were not taken into account in that volume.

Axeheads, fieldwork and the social sciences: *Programme JADE*

In parallel with these strictly specialist petrological approaches, two of us (Anne-Marie and Pierre Pétrequin) began, in 1984, to develop ethnographic models based on the systematic study of the last agricultural communities in New Guinea to produce and use polished stone axe- and adze-heads. The aim of this work was to understand the technical and social system of these objects in its entirety. In other words, the approach encompassed not only the study of production and polishing, but also considered the modalities of circulation, of transfer, of exchange and gift-giving; the use of these objects, ranging from their employment as workaday tools to their deployment as symbolic objects in compensation payments; the attribution of social standing to these items, and the religious rituals relating to (or involving) them (for a summary of this New Guinea work, see Pétrequin & Pétrequin this volume and also Pétrequin *et al.* 1993b; Pétrequin *et al.* 2006d).

A whole series of new ideas regarding the interpretation of the technical and social system of polished stone axeheads has emerged from these ethnographic investigations. These allow us to develop alternative working hypotheses to those of simple, conventional logic (that is, the sacrosanct Western notion of 'common sense'). We are not seeking to make like-for-like comparisons between the populations of 20th/21st century New Guinea and Neolithic Europe; we are all too aware of the dangers of undertaking such strict comparison-making. Rather, we are attempting to test indisputable patterns that have been observed in contemporary New Guinea against the evidence from the past. By applying models constructed using these insights – especially regarding the exploitation of primary sources of rock, where



the abundance of material permits both large-scale production and the transfer of technical knowledge through apprenticeship – we rapidly succeeded (from 1989) in discovering large quarries of pelite-quartz and of nodular schist in the southern Vosges, finding some 200,000 cubic metres of roughouts and working debris. Hitherto, petrologists and prehistorians had concluded that production of axeheads of these rocks had been episodic and based on cobbles taken from river beds (Piningre 1974).

In order to test out these new interpretations regarding the mode of production and the transfer of axeheads, we undertook an initial programme of research on the production and distribution of workaday axeheads in the southern part of the Vosges massif (Pétrequin *et al.* 1995). Some 30,000 such axeheads have been petrologically identified, and they are found in the east of France, Switzerland and south-west Germany. We created a typological seriation, collated information about finds from culturally and chronologically-diagnostic contexts, and systematically mapped the distribution of finished axeheads, roughouts and working sites. It was clear, however, that one could not understand this system of production and distribution (which dated to the 5th millennium and the beginning of the 4th) without taking into account other phenomena – in particular the circulation of large Alpine axeheads between the Alps and the Morbihan – and without applying a kind of reasoning that is rooted in ethnology and in the social sciences. Thus, our regionally-based interpretation of the Vosges quarries of Plancher-les-Mines (Haute-Saône) and Saint-Amarin (Haut-Rhin) took into account higher-level hypotheses that pertained to the whole of western Europe (Pétrequin *et al.* 1995:103–20). In other words, we had to call upon the phenomenon of the long-distance transfer of ‘ceremonial’ Alpine axeheads in order to account for the social conditions that applied to the regional production of axeheads in the southern Vosges. This study launched the idea that Alpine axeheads could be regarded as a bell-wether, showing how societies functioned during the 5th millennium.

Around the same time, Serge Cassen, along with Christine Boujot and Gérard Bailloud, developed the hypothesis that the Gulf of Morbihan, on the southern coast of Brittany, was where the earliest megalithic architecture in Europe emerged (in the form of giant mounds, carved stelae and alignments of standing stones). Within the belief system that was expressed in these monuments, and among various ‘object-signs’ that were carved on the

stelae such as the *crosse* (throwing weapon shaped like a hockey stick) and the *cachalot* (sperm whale), the Alpine axehead played a prominent role as a particularly significant object, at least from the middle of the 5th millennium (Boujot & Cassen 1992; Bailloud *et al.* 1995; Cassen 2000). Furthermore, a symmetry between Carnac and the Gulf of Morbihan on the one hand, and Varna on the other, was seriously envisaged.

The foundations for a collaboration with Cassen *et al.* were rapidly established in 1996 and a small team was formed to undertake a general study of Alpine axeheads across western Europe. This involved a systematic typological and chronological review of all axeheads longer than 14 cm (in order to avoid the examples that had been re-used as tools or reshaped at a much later date). The idea of creating a general map of the various types of Alpine axehead had already been proposed by Pierre-Roland Giot (1965) but without success, because it soon became clear that this would be a colossal undertaking. Our initial small team was soon joined by Michel Roissy, who undertook to examine the petrological thin sections of raw material samples from the Alps (Pétrequin *et al.* 2006c). From 2000, Michel Errera added his expertise in the field of spectroradiometric analysis, a technique that is totally non-destructive and cheap to undertake and which had not hitherto been used to analyse prehistoric artefacts. The use of this technique, along with the reading of petrological thin sections, the measurement of specific gravity and X-ray diffraction (XRD) analysis (the last undertaken at Laboratoire GeaDue in Bologna, by Massimo Ghedini and Claudio D’Amico), proved to be extremely useful in comparing axeheads with raw material samples, in particular as far as jadeitites are concerned (Errera *et al.* 2006, 2007, 2008; Pétrequin *et al.* 2005, 2006b). It is clear that if we had not used the non-destructive technique of spectroradiometry, museum curators would not have allowed us to analyse their axeheads, bearing in mind the damage inflicted on certain very beautiful examples over the last 40 years through sawing, breaking off or coring pieces to make thin sections.

Other colleagues joined the team: Christophe Croutsch undertook a study of the techniques of sawing Alpine rocks in Switzerland (2005); Lutz Klassen brought his knowledge of the earliest use of copper and gold in Europe and was in charge of gathering material from Germany and Denmark (Klassen 2000, 2004); Alison Sheridan and Yvan Paillet covered Brittany, Great Britain, Ireland and the



Channel Islands (Pailler 2007; Pailler & Sheridan 2009); Guido Rossi, Eugenia Isetti and Patrizia Garibaldi covered Liguria (Gaggero *et al.* 1993); Nicolas Le Maux (2007) and François Giligny dealt with the Paris Basin, Ramon Fabregas Valcarce (1982), and Arturo De Lombera Hermida and Carlos Rodriguez Rellán covered Spain and Portugal. Finally in 2007, this team – which started off as a completely informal grouping – was formalised as part of a *Programme “Blanc”* of the *Agence Nationale de la Recherche*, under the name ‘JADE’. Estelle Gauthier joined this multi-disciplinary group as a GIS specialist, responsible for the mapping of axeheads across the whole of western Europe.

An initial article about *Programme JADE* was published in 1997 (Pétrequin *et al.* 1997d). The principal aim of the project was to present a definitive statement about axeheads made from Alpine rock, including a comprehensive photographic record and database of every axehead over 14 cm long in Europe (the current total of which stands at 1623). This database records the context of discovery, typological characteristics (recorded systematically as line drawings), dimensions, the quality of the polish, the nature of the rock (recording both macroscopic identifications and those obtained through spectroradiometry), the origin of the raw material (as determined through comparison with raw material samples), the current location and bibliographic references. Thus, *Programme JADE* set out to create a major research tool. In parallel with this work – and making a break with previous hypotheses that had proposed that the raw material had simply been gathered in cobble form in torrent beds at the foot of the Alps – Anne-Marie and Pierre Pétrequin undertook twelve consecutive seasons of field prospection in the high Alps, in order to establish a representative collection of raw material samples. (To date, this reference collection comprises over 2000 specimens.) This systematic, valley by valley prospection led, in 2002, to the discovery of the first free-standing *boudins* (blocks shaped like a blood pudding) of jadeitite, in either primary or secondary positions, in the Mont Beigua massif. Thereafter, in June 2003 and June 2008, the first evidence for the Neolithic exploitation of blocks of jadeitite, eclogite and amphibolite was found in the Mont Viso massif (Pétrequin *et al.* 2005, 2006b and c, 2007a and b). The blocks had been exploited using fire-setting to detach thermal flakes. Notwithstanding these spectacular results, it has still not yet been possible to discover the location of all the raw material sources that were exploited during the Neolithic. Many more years of prospection will

be necessary to cover the Mont Viso and Mont Beigua massifs, let alone any other source areas.

Research into Alpine axeheads is therefore currently situated within well-defined parameters. It is very different from the research that had previously been undertaken, which had focused on isolated axeheads, on regional mineralogical studies, or on creating typological classifications within a geographically-restricted area (Thirault 2004). This previous work had not related the axeheads to the source areas that were exploited, nor had it considered the conventions of the reduction process as revealed clearly in the axeheads themselves. In theory, thanks to the standardised recording undertaken by *Programme JADE*, it is now possible to approach the study of Alpine axeheads on a Europe-wide scale (while not ignoring their regional peculiarities), examining every aspect from the high-altitude extraction and working of the raw material to the deposition of axeheads in a hoard or an exceptional grave, or planted in the ground at the foot of a stela, on a mountain col, or in a wetland context. It would appear that this research tool finally provides us with the best way to test the hypotheses that are thrown up by the social sciences, by ethnoarchaeology (and here let us not forget the conceptual power of the discovery of the quarries on Mont Viso) and by experimentation. The rest of this contribution will attempt to demonstrate this through several examples.

Jadeitite versus eclogite: myth or reality in the choice of colours

In a preliminary study (Pétrequin *et al.* 2002), we observed the considerable variety in the Alpine eclogites, omphacitites and jadeitites used to make the large Neolithic axeheads. This variability can be seen with the naked eye (Fig. 1) and is confirmed through petrological analysis; indeed, this variability makes it difficult to determine the precise origin of these rocks on the basis of thin sections or XRD analysis. (See, for example, Ricq-de Bouard 1996; and Compagnoni *et al.* 1995, 2007). Equally, we observed that in certain parts of Europe, notably southern France and Italy, large axeheads made of dark-coloured eclogite/omphacitite (and also, probably, several dark green fine-grained jadeitites that have otherwise been labelled ‘chloromelanite’) are in the majority, whereas in the Paris Basin and Britain and Ireland, by contrast, axeheads of eclogite/omphacitite are in the minority and light green and generally

Fig. 1.
Examples of large, intensively polished axeheads of Alpine rocks. The great typological diversity implies a long chronology of production, covering most of the 5th millennium and part of the 4th.





PEYRIAC-DE-MER
(Aude, France)
Jade 2008-814



CARNAC / SAINT-MICHEL
(Morbihan, France)
Jade 2008-511



LATERZA
(Italy)
Jade 2008-1264



MONTREDON
(Aude, France)
Jade 2008-755



WROOT
(Grande-Bretagne)
Jade 2008-78



LANGSUHR
(Germany)
Jade 2008-255



translucent jadeitites predominate. The boundary between these two patterns falls on either side of a notional line between Geneva and Le Havre, with Brittany and the Loire Valley constituting an exception, having a roughly equal number of dark- and light-coloured axeheads. Furthermore, by and large this opposition seems to correspond to different typological groupings, with southern axehead types being made predominantly of eclogite/omphacitite and northern types being made predominantly of jadeitites.

These observations, which were based on the examination of 600 large axeheads, were not entirely new, even though the number of axeheads investigated far surpassed those of previous studies. On the basis of examining several museum collections, Edouard (M.) Desor (1873) had already remarked upon this difference in colour and texture between the Alpine axeheads found in Germany and Belgium on the one hand, and in the south of France on the other. Working with a similarly small number of axeheads from Britain and the Continent that belong to museums in Britain, but this time having much more detailed mineralogical information to hand, Woolley and his colleagues (1979) reached the same conclusion, noting a global opposition between southern axehead types (long, narrow, thick-sectioned and dark green in colour) and northern types (broad, thin and light green in colour).

Thus, these three studies produced near-identical results, whether they were based on macroscopic examination, as in Desor's work, or on petrological, mineralogical and/or compositional analysis (Woolley *et al.* 1979; Pétrequin *et al.* 2002). An initial and tentative explanation was offered in the last two studies, proposing that different quarries had been exploited. At the time when these studies were undertaken, no Neolithic working sites had yet been found, although several groups of rough-outs had been found on the periphery of the Mont Beigua massif (Traverso 1898, 1901, 1909; D'Amico *et al.* 2000, 2006; Venturo Gambari 1996).

In a synthetic study of axeheads of Alpine rock in Italy and elsewhere in Europe, D'Amico *et al.* (2003) offered an alternative view. Having analysed a large set of small axeheads from Italy (from petrological thin sections and XRD analyses) and small sets of axeheads from France and Luxembourg (by macroscopic examination), the authors adopted a view that contrasted with that put forward in the three other studies:

*"The general trend of an increase in jade implements with respect to eclogites, gradually moving away from the sources, is a clear cultural selection already noticed in Italy... Clearly, the importation strategy is here prevalently oriented towards obtaining ritual/prestige objects of exotic materials, possibly made more precious by their long-distance provenance and therefore even aesthetically more selected (more jades than eclogites)... Many problems remain open and any conclusion should be considered premature, due to still insufficient petroarcheometric studies on stone axes. For instance, there is an apparent discrepancy between the preliminary data reported here and the Geneva–Le Havre line (Pétrequin *et al.* 2002) dividing areas with prevalent 'eclogite vert foncé' and with prevalent 'jadeite verdâtre saccharoïde'."*

These two positions are contradictory, not only in the nature of the observations but also in the interpretation of spatial variability. One proposes an opposition between dark- and light-coloured rocks, probably associated with different types of axehead (and consequently with an evolution over time); the other rejects this idea of an opposition even though it emphasises the cultural selection of light-coloured rocks over dark-coloured rocks and notes an increasing use of the former with increasing distance from Italy, towards the Atlantic coast of Italy, ignoring the chronological dimension. The fact that the first position is based solely on the examination of large axeheads, whereas the second is based on large and small axeheads, might indeed lead to certain distortions. However, this cannot account for the opposition. Now, with the *Programme JADE* database at our disposal (comprising over 1600 records as of November 2007), it is easier to examine the picture more clearly at a pan-European scale.

Alpine quarries and Europe-wide distribution patterns

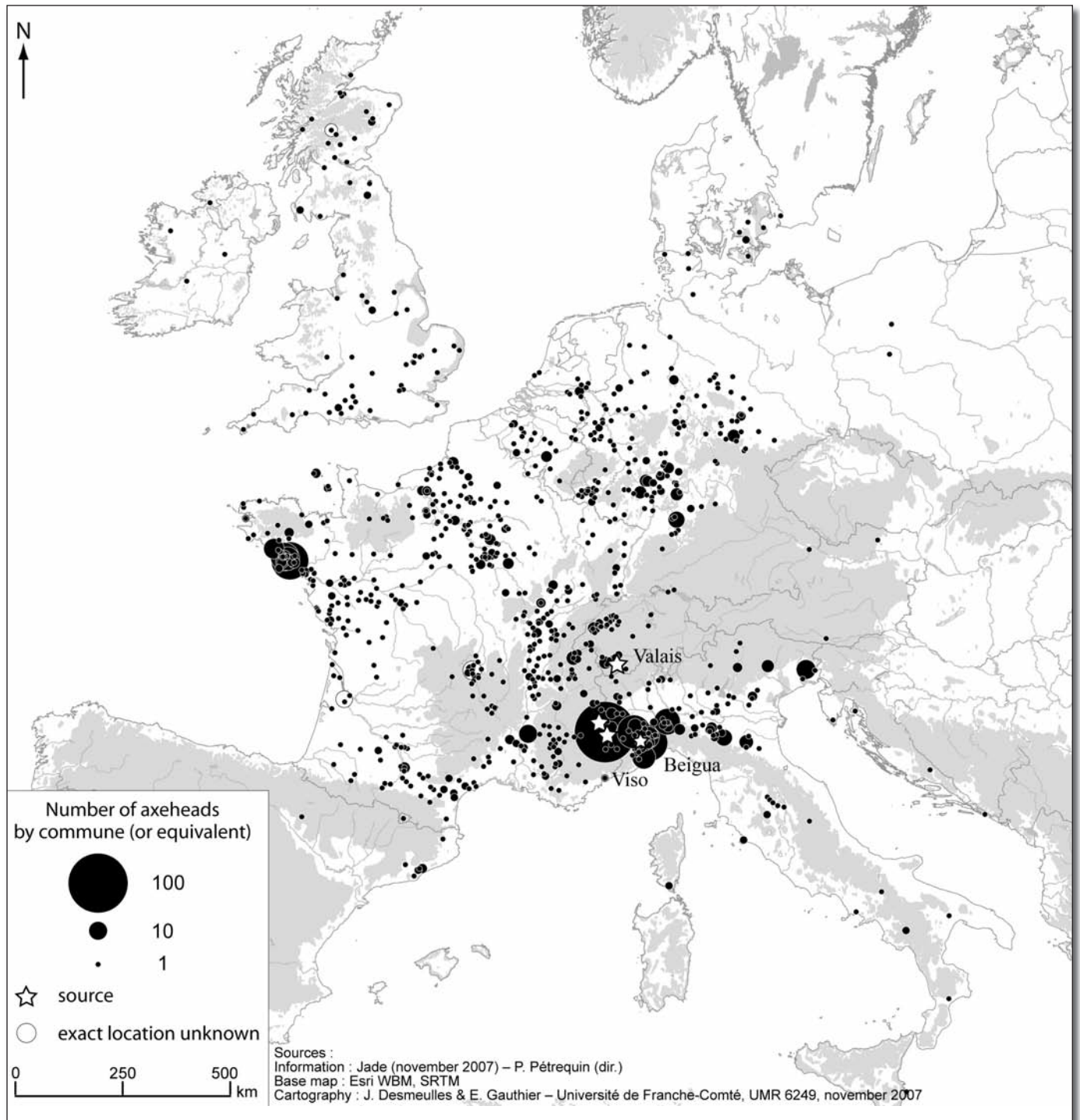
The map showing the overall distribution of axeheads made from all the Alpine rock types (eclogite, omphacitite, jadeitite, amphibolite and nephrite) across Europe (Fig. 2) allows us to see clearly, and at a glance, its geographical patterning and extent. This remarkable concentration in western Europe contrasts with zones where Alpine axeheads are rare or totally absent: Spain, the Iberian peninsula and east-central Europe. In these areas, the ways in

Fig. 2.

General distribution of all the axeheads of Alpine rock longer than 14 cm. The stars indicate the main raw material sources (eclogite, jadeitite and nephrite).

Cartography by
Jonathan Desmeulles
and Estelle Gauthier,
November 2007,
using *Programme JADE*
data collected by
Pierre Pétrequin.





which society functioned and rituals were conducted relied upon other ways of indicating status and power and other objects, such as the pottery of Serra d'Alto in Italy, copper and gold in the region of Europe that was the first to experience the Chalcolithic (Pétrequin *et al.* 2002; Klassen 2000; Klassen *et al.* forthcoming a). There also seem to be blank areas and gaps within the area where the axeheads circulated: among other examples, the lacuna in the mountainous region of central France may be explained in terms of the nature of the soil and

the limited opportunities they offer for cereal growing (excepting the Limagne and the Puy Basin). However the large blank zone between the Pas-de-Calais and Lorraine is harder to understand; it corresponds in part to the major battlefield areas of the two World Wars and it may also reflect the relative paucity of research in that region.

As for the most important concentrations of axeheads, these correspond closely to the exploitation areas on Mont Viso and Mont Beigua, where our prospections have found



Fig. 3.
The Neolithic exploitation
on Mont Viso.

Top:
the source area on col
Barant at Bobbio Pellice
(2400 m above sea level);
the blocks exploited
by fire-setting are
located on the crest
towards the front.

Bottom:
roughouts and
hammerstones from the
quarries of Barant and
Vallone Bulè at Oncino.

Photos and information:
Anne-Marie and
Pierre Pétrequin.



VISO BARANT
point A, Jade 2008-1168



VISO BULE
point 69



VISO BULE
point 108, rock shelter C

0 10cm



thousands of roughouts (Fig. 3). These new discoveries overturn the previous distribution maps of axeheads in the high Alps, which had suggested that there had been very little extraction during the Neolithic, particularly on Mont Viso.

The second remarkable concentration is to be found on the southern coast of Brittany, in particular around the Gulf of Morbihan, which constituted an exceptional area of attraction for Alpine axeheads and for beads and pendants made from Iberian variscite (Cassen *et al.* 1999; Herbaut 2000; Herbaut *et al.* 2004). We shall return to this area.

At the broadest scale, it is clear that the circulation of large Alpine axeheads away from the source areas did not occur with the same intensity in different directions (which would have been the case had the social distance between Neolithic communities been the same: Pétrequin *et al.* 2003b). In contrast, with the exception of north Italy, the majority of Alpine axeheads are to be found on the other side of the Alps, in the direction of Brittany, Scotland and Denmark. Such an asymmetrical distribution indicates that different social circumstances obtained in different areas, and this needs to be explained: such differences might be able to account for the marked differences in the petrological composition of assemblages in north Italy and in the rest of western Europe (D'Amico *et al.* 2000b, 2003).

All the evidence suggests that the large Alpine axeheads had a relatively minor social value in the Po plain, close to the source areas of the raw material. Similarly, downstream from Turin, the majority of ground stone tools were made from low quality eclogite, from relatively soft omphacite schist, from coarse-grained jadeitite-quartz, in very laminated amphibolite and in serpentinite, while objects made from true, high quality jadeitites are rare (e.g. at the working site at Rivanazzano: D'Amico *et al.* 2006). However, this spectacular map runs the risk of giving a false impression, because it represents a palimpsest of all the large axeheads, irrespective of their chronological position within the period c 5000–3000 BC. Nothing in this document allows us to determine whether the circulation of large axeheads took place in the same manner and at the same time throughout Europe, or indeed whether the same types of axehead or the same relative proportion of materials used were involved in all the areas of Europe in question over these two millennia.

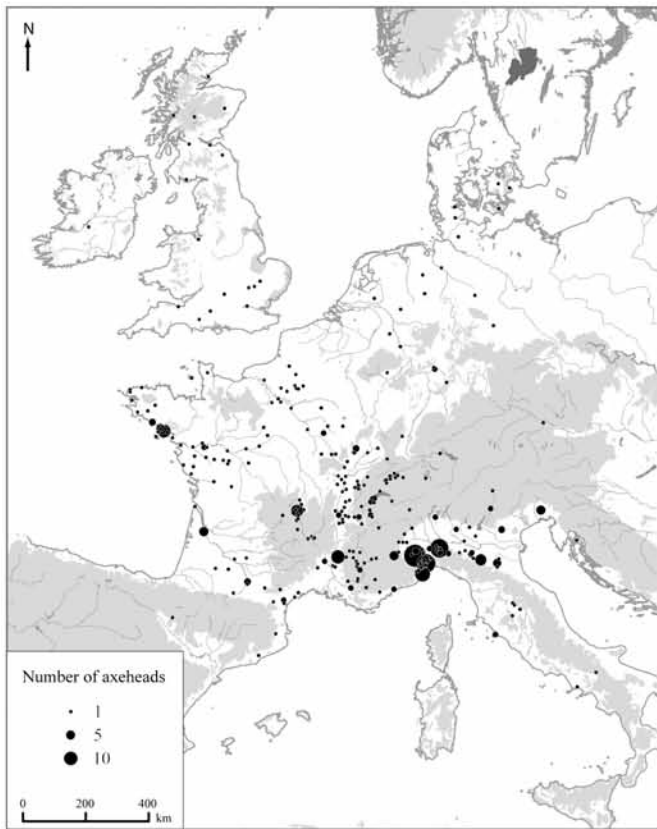
Eclogite-omphacite and jadeitite in Europe

This general distribution map of large Alpine axeheads in Europe (Fig. 2) which compacts data spanning around two millennia, masks the use of different materials. So, to assist our proposition that we can oppose dark-coloured and light-coloured axeheads, we propose to use two complementary maps (Fig. 4, *top*). At the left of this illustration we have grouped the axeheads made from eclogite and omphacite. Their distribution covers the whole of western Europe, but the zone of densest concentration lies in northern Italy and southern France, with a northern limit falling roughly in a line between Berne in Switzerland and Rouen in France. The general tendency seems to be a circulation away from the Alpine quarries in the direction of the Gulf of Morbihan, following two routes: the Saône valley; the southern part of the Paris Basin and the lower valley of the Loire; the lower valley of the Rhône, Languedoc, the Bordeaux region and the lower valley of the Loire. In each case, the Gulf of Morbihan seems to be the point of attraction for these large Alpine axeheads made of dark-coloured rocks.

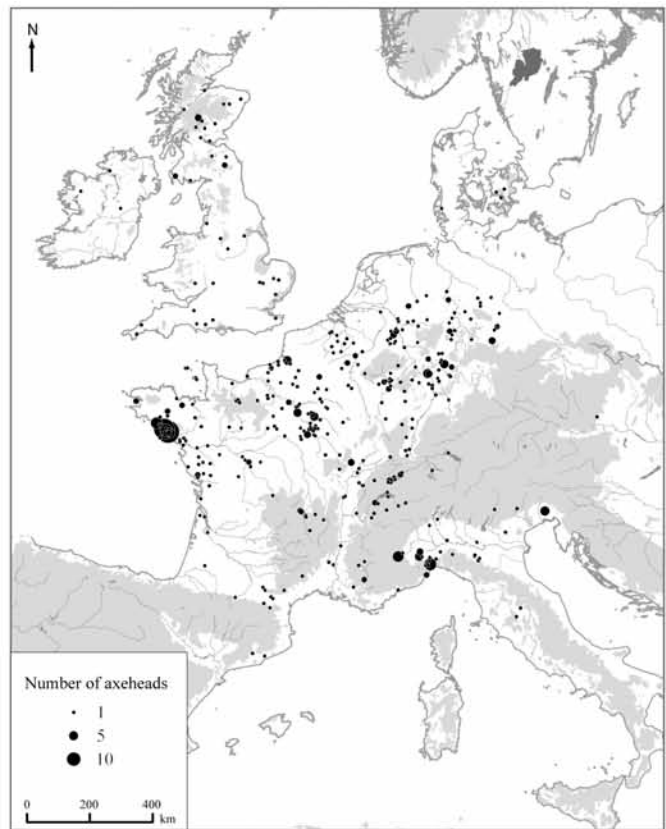
At the top right of Fig. 4, a second map shows the distribution of axeheads made from light-coloured rocks of the jadeitite family. Once more, the distribution extends over the whole of western Europe, but with a far denser concentration around the Gulf of Morbihan, in the Paris Basin, in Germany and in Great Britain. A southern edge to this distribution can be traced between Berne and Caen, with the Gulf of Morbihan once more being the exception, having a large number of these jadeitite axeheads.

There is always an element of uncertainty inherent in some macroscopic identifications. The same may have also been true in the past; Neolithic people did not have at their disposal any other means of identifying polished jadeitites beyond the fact that the stone is much tougher than other Alpine rocks. However, what can be said with some confidence is that there is an evident opposition between a south-eastern part of Europe dominated by dark-coloured axeheads and a north-western part dominated by light-coloured axeheads. There is of course a degree of overlap between these two distribution areas, which probably corresponds to the principal route along which axeheads travelled from the Italian Alps to the Morbihan, via the Saône, the Morvan, the centre of the Paris Basin and the Loire Valley. The concept of a progressive cultural 'selection' of





Eclogite, omphacitite



Jadeitite



VISO, Vallone Bulè



VISO, Porco



Fig. 4.

Map, at the scale of western Europe, showing that the distribution of axeheads of dark-coloured alpine rocks (mainly from the family of eclogites and omphacitites, top left) contrasts with that of axeheads of light-coloured rocks (above all jadeitites, top right).

Most of these axeheads result from open-air exploitation of raw material sources at the foot of the Mont Viso massif, at Vallone Bulè (bottom left) and at Chiot del Porco (bottom right); the products from col Barant (Fig. 3, top) and of the Mont Beigua massif seem to be less well represented.

Cartography by Estelle Gauthier; photos: Pierre Pétrequin.

jadeitites along the course of the transfers from Italy to the Atlantic fringe of Europe (D'Amico *et al.* 2003) cannot therefore be sustained, given the overall distribution of the large axeheads.

In the extraction areas of Mont Viso (Fig. 4, bottom) one finds that fine eclogites, omphacitites and jadeitites belong to the same geological zones. Occurring as *boudins* and as blocks enveloped within a kind of 'purée' of soft, pasty serpentinite, these three types of rocks can coexist within several dozen metres of each other, with each block having its own specific history within the metamorphic process (Compagnoni *et al.* 2003, 2007; Pétrequin *et al.* 2007a). Given this variability in the geological process that gave rise to these rock types, there is consequently a considerable variability in eclogites, omphacitites and jadeitites in the primary source areas (namely Viso/Vallone Bulè, Fig. 4 bottom left; Viso/Vallone Porco, Fig. 4, bottom right; Viso/Barant, Fig. 3, top; and Pontonvrea in the massif of Mont Beigua: Pétrequin *et al.* 2006c).

The trial excavations undertaken in September 2007 at Oncino/Bulè/Circle of Blocks (Pétrequin *et al.* 2008b) showed that, amidst the hundreds of cubic metres of flakes and broken roughouts created by hard hammer knapping, pieces in eclogite/omphacitite were far more common than those in jadeitite. However, the way in which the raw material was worked differed according to the raw material used. In effect, in Vallone Bulè and Barant, the length of the broken roughouts made of eclogite is often in excess of 10 cm and can be as long as 20 cm; in contrast, the length of broken jadeitite preforms and of the majority of flakes is most frequently less than 5 cm. In these high-altitude working areas, this different composition of the debitage tends to show that jadeitite was of higher value than the other rocks that were exploited. Consequently, preforms and roughouts in jadeitite – even those of quite small size – must have been systematically taken down into the valley to be hammered, ground and polished, while the norms of abandonment meant that the other rocks, of lower value, were more wasteful of the raw material. In other words, large roughouts of eclogite would be rejected as soon as a crack or an imperfection was spotted in the raw material (Fig. 3, bottom left). Thus, the selection of raw materials, and in particular of jadeitite, probably informed the nature of the exploitation of the blocks and the preparation of the roughouts. This raw material selection was facilitated by the fact that each of these rocks reacts in a different way to the blow of a hammerstone and

that thin flakes of translucent jadeitite often have a characteristic luminous pale green colour.

Typo-chronological evolution of the relationship between eclogite-omphacitite and jadeitite

In attempting to resolve the problem of the opposing distributions of dark-coloured versus light-coloured rocks (Fig. 4, top), we propose to introduce two variables: the typological classification of the axeheads and the chronological evolution of types. We have demonstrated elsewhere that the formal variability of large Alpine axeheads (of which several examples are shown in Fig. 1) could relate to a long-term chronological evolution (Pétrequin *et al.* 1997, 2002). An initial typological classification allows us to identify the principal types of large axehead in terms of their overall shape, the shape of their blade and their shape in cross-section (Pétrequin *et al.* 1997, 2002). Each of these types has been given a name corresponding to the findspot of the first axehead to be thus identified (e.g. Bégude, Bernon, Puymirol: Fig. 5). A chronological ordering was then proposed, based on the study of hoards and funerary assemblages, comprising between two and (in the case of the tumulus of Tumiac at Arzon, Morbihan) 18 examples containing more than one type of axehead. Another way of identifying chronological changes was to observe the successive transformations in the shape of an axehead as it underwent several episodes of repolishing (e.g. to convert an Altenstadt type into a Puy type). This typological seriation was then placed within a chronological order by taking into account the examples that had come from dated or datable contexts (e.g. through association with stone disc-rings, with pottery, or with radiocarbon or dendrochronological dates).

Figure 5 presents our current state of knowledge of the chrono-typology of Alpine axeheads. It differs significantly from our earlier versions (in particular Pétrequin *et al.* 2002) because the classification has had to be revised each time a new hoard of axeheads has been registered in the *Programme JADE* database. The version published here, which presents the average dates along the axis linking the Alps with the Morbihan, may have to be amended in the light of new data. Nevertheless, it demonstrates the complexity of typological evolution, while at the same time allowing us to identify when, during the period between

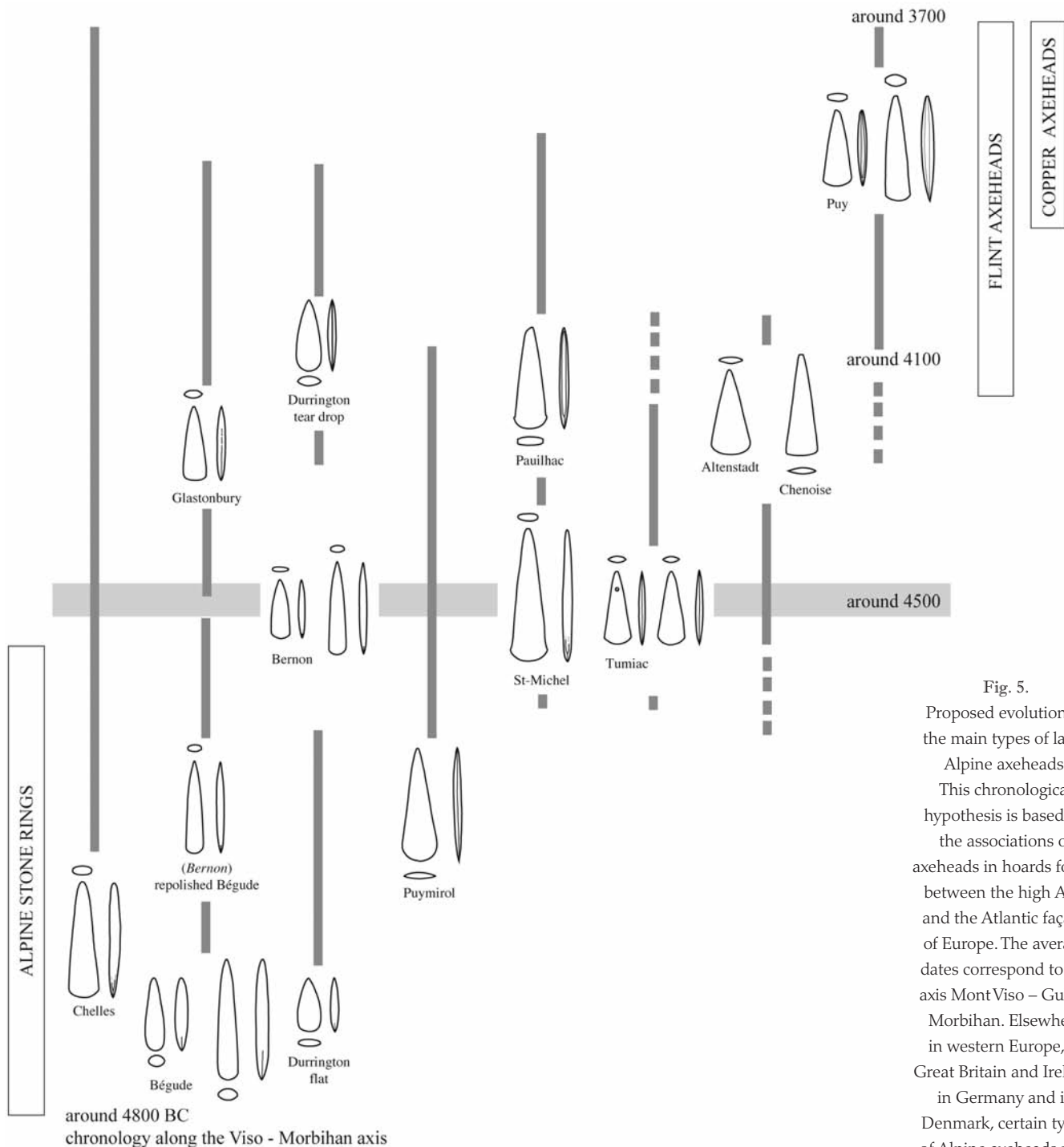


Fig. 5.

Proposed evolution of the main types of large Alpine axeheads.

This chronological hypothesis is based on the associations of axeheads in hoards found between the high Alps and the Atlantic façade of Europe. The average dates correspond to the axis Mont Viso – Gulf of Morbihan. Elsewhere in western Europe, in Great Britain and Ireland, in Germany and in Denmark, certain types of Alpine axeheads may have been introduced and used later, no earlier

than the end of the 5th millennium.

Drawing:
Pierre Pétrequin.

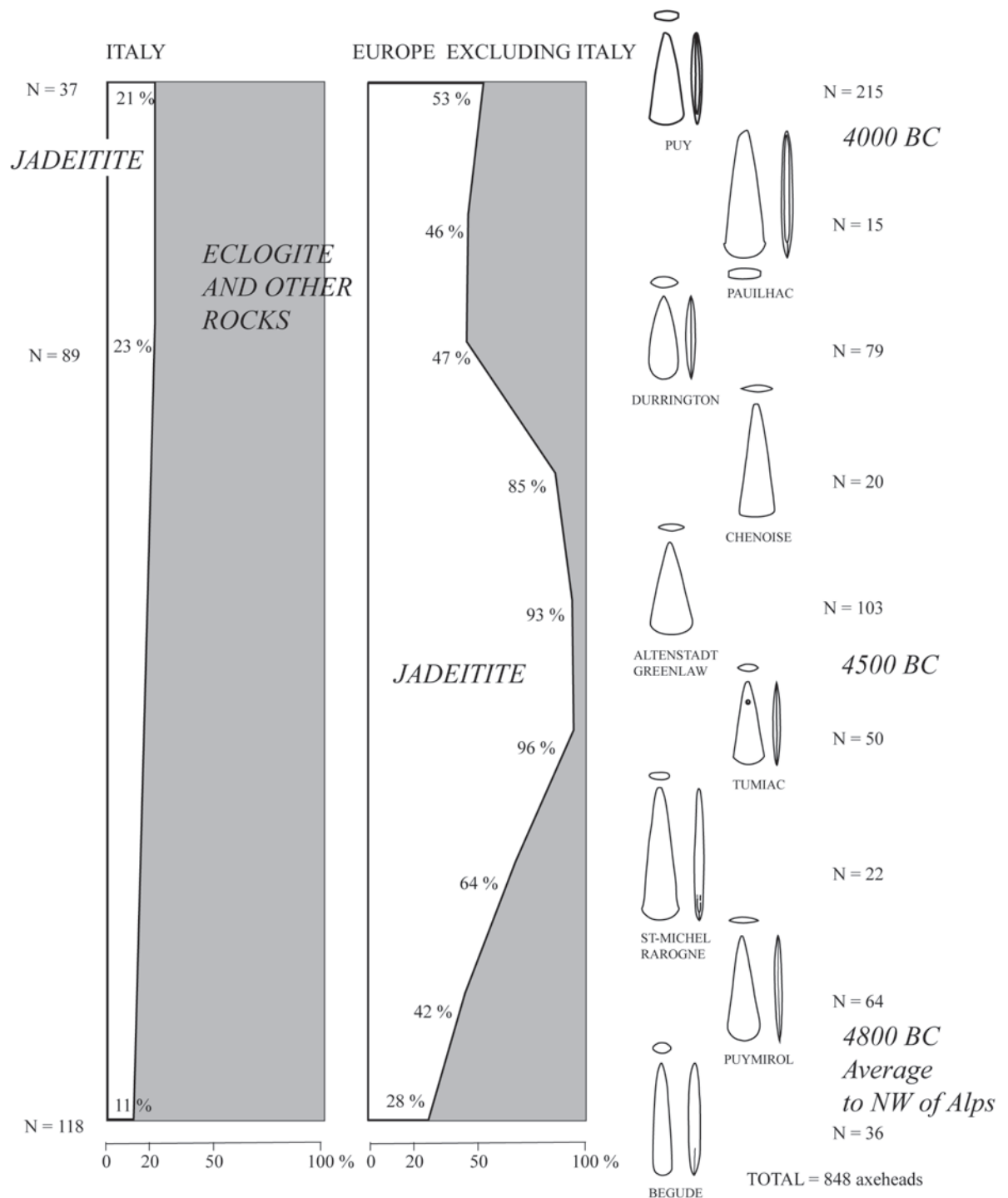
4800 and 3700 BC, certain types of axeheads appeared, reached their peak of use and then declined along this Alps – Morbihan axis.

Out of a total of 1600 large axeheads included in the *JADE* database, 966 have had their precise petrographic composition identified (i.e. through spectroradiometry and/or other techniques) or have been identified macroscopically by at least one member of the team. Thus, we can now calculate the percentages of jadeitite use for each of the types of

Alpine axehead, and hence the intensity of use over time, since we have an idea of the chronological position of each type (Fig. 6). Because the relationship between the use of eclogite/omphacite/jadeitite in North Italy seems to differ from that seen in the rest of western Europe (e.g. D'Amico *et al.* 2003), we have split our presentation into two columns in order to show this difference. The left hand column corresponds to 118 large axeheads in Italy, and the right hand column to 848 transalpine examples,



Fig. 6.
Typology of Alpine
axeheads and raw
materials. The choice of
raw material (jadeitite or
eclogite and other rocks)
varied over the course
of the 5th millennium.
To the north-west of the
Alps, a predominance of
light green jadeitites can
be seen towards the
middle of the 5th
millennium,
corresponding to
axeheads of Tumi-
ciac, Al-
tenstadt, Greenlaw
and Chenoise types.
However, this
evolution in the use of
raw materials does not
seem to have occurred in
North Italy, lying much
closer to the extraction
areas of Mont Viso and
the Mont Beigua massif.
Drawing:
Pierre Pétrequin.



corresponding roughly to the rest of Europe between the Alps and the Atlantic.

The criteria used in the choice of raw material for the large axeheads allow us to demonstrate that there were indeed significant differences between North Italy and the rest of Europe. In Italy, large jadeitite axeheads are not common and show just a small increase over time, from around 15% to 21% (according to the JADE database). In contrast, on the other side of the Alps, jadeitite is abundant, and with

some types of axehead (e.g. Tumi-
ciac and Al-
tenstadt-Greenlaw) comprises as much as 96% of all specimens. Furthermore, there seems to be a chronological logic in the changing use of jadeitite over time. At the beginning of the 5th millennium only around 28% of axeheads are made of this material, whereas by around 4500 BC the total has risen to an average of 95%. By the beginning of the 4th millennium it had fallen, stabilising at around 50% of all axeheads. This trend, of an increasing then

decreasing use of jadeitite, can be interpreted in terms of a changing pattern of exploitation: from its initial use, it became the preferred rock type and was extracted until the sources became progressively exhausted. At the same time, it is likely that this rarest of materials was accorded an increasing social value, and was then subject to a kind of progressive disaffection as other types of socially valorised objects came to be used. The overall pattern of raw material use can be summarised, then, as follows:

- * At the beginning of the 5th millennium, networks became established through which axeheads and other items circulated. These involved a wide range of rocks – we may think in terms of an exploratory phase of raw material use – with eclogites and omphacitites being the commonest rock types in use. These slightly laminar rocks are better suited to the manufacture of long narrow axeheads (like those of the hoard at La Bégude-de-Mazenc, Drôme, for example: Thirault 1999) or to ring-discs (Rossi *et al.* 2008) than is jadeitite;
- * Around the middle of the 5th millennium: we see the apogee of the use of jadeitite, culminating in the ‘Carnac phenomenon’ of monumental tombs, standing stones and rituals around the Gulf of Morbihan;
- * Subsequently, the relative depreciation and devaluation of jadeitite, and a renewed increase in diversity of raw materials used, in particular in the frequent use of serpentinites.

This gradual diminution in the use of jadeitite could illustrate an adaptation of the norms of exploiting the raw material sources, with the best rocks becoming increasingly hard to find. Furthermore, during the second half of the 5th millennium, the technique of sawing blocks using thin pieces of wood (with crushed quartz and water) began to develop; this technique allowed the optimum number of axeheads to be obtained from each block that was exploited (Pétrequin *et al.* 2002; Croutsch 2005).

The introduction of typology and chronology into our line of reasoning has therefore allowed us to explore in detail the question of the relationship between dark- and light-coloured Alpine rocks. This has highlighted the dynamic nature of raw material selection at the high-altitude extraction sites and in the villages in the valleys where large axeheads were produced.

Three different axehead types

Three different episodes of Alpine axehead production can help to clarify matters. We shall compare, at the scale of western Europe, the distribution of Bégude type axeheads, the oldest type according to our typochronology, made mostly of eclogite-omphacitite-amphibolite, with that of axeheads of the family Altenstadt-Greenlaw (which are partly contemporary with the high point of axehead production and which are predominantly made of jadeitite), and finally that of Puy type axeheads (the most recent type, made from a variety of materials comprising eclogite, omphacitite, jadeitite, serpentinite and amphibolite).

Bégude type polished axeheads

During the first half of the 5th millennium, Bégude type axeheads, which are in fact long adze-heads which would have been hafted in an elbow-shaped haft, have a distribution that is what one would expect to see for workaday tools that are more or less heavy-duty (Fig. 7), namely:

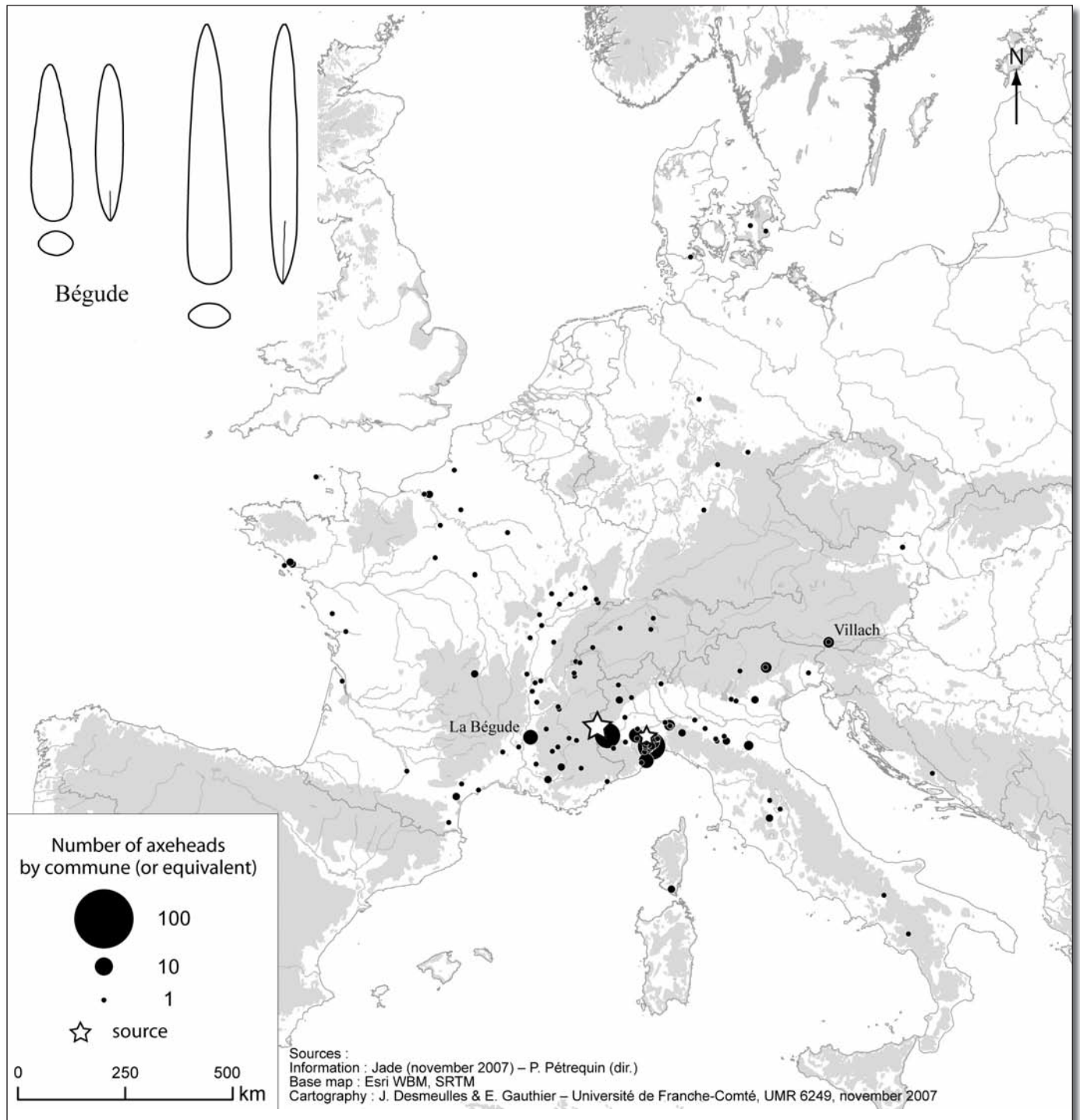
- * Two very important concentrations of rough-outs, coinciding with Mont Viso and, to a lesser extent, the Beigua massif; the latter supplying north Italy with products of mediocre quality;
- * A large, even area of distribution, centred on the raw material sources, extending in all directions up to 250 km away; the valleys of the Saône and Rhône form the western limit and the Alpine arc and the Apennines form the northern and southern limits;
- * Two very important hoards comprise ten axeheads (at the eponymous site of Bégude-de-Mazenc, Drôme, France) and seven at Villach/Kanzianiberg (Austria), which lie at the western and eastern confines respectively of the distribution pattern for users of Bégude-type axeheads. The location of these hoards encourages us to interpret them as having had some particular social significance;
- * Beyond 250 km from the source area there are a few isolated examples (sometimes associated with ring-discs of jadeitite or serpentinite). These attest to transfers via the north and the south of the Massif Central, as far as the Gulf of Morbihan, where they are found in the giant Carnac-type tombs, often in the form of long blades that have been thinned down by repolishing. Clearly they had obtained a different status, as socially-valorised objects: the polished tool had been turned into an ‘object-sign’;

Fig. 7.

Distribution of large axeheads of Bégude type, corresponding to production at the quarries of Mont Viso and Mont Beigua between 4800 and 4500 BC. The use of jadeitite is less common with this type of axehead (Fig. 6, bottom); eclogites, omphacitites and dark amphibolites dominate.

Cartography by Jonathan Desmeulles and Estelle Gauthier, using *Programme JADE* data collected by Pierre Pétrequin.





* As for the very rare Bégude type axeheads found in Germany and Denmark, it may be that these were individual specimens that had been treasured over a very long time and deposited during the 4th millennium (Klassen *et al.* 2005).

The distribution of Bégude type axeheads, dating to the first half of the 5th millennium, conforms well with a pattern of distribution observed in a few cases in New Guinea, in particular the glaucophanite axeheads of the

Wang-Kob-Me quarries (Pétrequin *et al.* 2002). Here there were one or two epicentres of production; an even distribution of products among the users of these workaday tools (the Wano and Moni linguistic group); and a few isolated outliers that signalled the existence of long-distance circulations, where the technical function of the tool was abandoned as the objects took on a purely social function. The examples found furthest away from the source were attributed to the world of status-marking, rituals and religion (among the Yali and Una groups).

Culturally, the producers of Bégude-type axeheads certainly belonged to the Square-Mouthed Pottery (V.B.Q.) Culture in Piemont and to Cardial tradition groups in the valleys of the Rhône and Saône. The intermediaries in the movements towards Brittany were the Villeneuve-Saint-Germain (V.S.G.) and the Cerny Cultures in the south of the Paris Basin, and the recipients in the Morbihan area on the south Brittany coast were the early Castelic Culture.

Finally, we should point out that the famous representation of the hafted axehead on the stele that was subsequently re-used as the cap-stone of the Table des Marchands at Locmariaquer (Morbihan) shows in fact two stages of carving: the earliest is an axehead of Bégude type, which was then refigured in order to portray a large axehead of Altenstadt-Greenlaw type (Cassen forthcoming).

Altenstadt-Greenlaw and Chenoise type polished axeheads

Just as the Table des Marchands carving showed that the Altenstadt-Greenlaw axehead post-dated the Bégude type, our typological seriation of large Alpine axeheads (Fig. 5) has shown that the Altenstadt-Greenlaw and Chenoise types are indeed later than the Bégude type – at least in the Morbihan.

Let us remember first of all that these two typologically close groups had been the subject of long-distance transfers and had reached the Carnac-type tombs from the middle of the 5th millennium. In these tombs, they often take the form Tumiatic type axeheads, which are Alpine examples that had been thinned down and had their shape modified by repolishing in the Morbihan; their blades are expanded. The ongoing spectroradiometric analyses of Michel Errera have shown that for all these types of axehead, the known sources of jadeitite (and probably also some other Alpine sources that have not yet been located) were used. The variants of this rock from Mont Viso include jadeitite with lawsonite crystals, jadeitite with zircons and jadeitite with garnets ‘floating’ in atolls; those from the Beigua massif include jadeitite-quartz and glaucophane jadeitite. In total, Alpine jadeitite was used for over 90% of all the axeheads of these types that we have studied (Fig. 6). This implies that, in contrast to the earlier raw material choices taken by the makers of Bégude-type axeheads, there had been an intensive selection of potentially usable Alpine rocks in order to obtain the beautiful light-green translucent jadeitites. It remains to be discovered how this selection was effected:

at or close to the sources, or in the course of their transfer towards the north and west?

The distribution (Fig. 8) is radically different from that of Bégude-type axeheads and is full of surprises. Some characteristic traits are as follows:

- * Axeheads of Altenstadt-Greenlaw and Chenoise type, corresponding to the apogee of the long-distance circulation of Alpine axeheads, have been found as far away as northern Scotland, some 1700 km away as the crow flies from the Beigua massif;
- * The diffusion took place solely in a northern direction (to Germany), a north-westerly direction (to the Paris Basin, Great Britain and Ireland) and a westerly direction (to the Morbihan);
- * No roughout of Altenstadt-Greenlaw type is known among the thousands of broken roughouts found in the Alpine extraction areas of Mont Viso. Indeed, the only roughout for this kind of axehead is the partly-sawn block that was found, at Lugin (Haute-Savoie), ritually deposited at the foot of a large erratic block (Pétrequin *et al.* 2008);
- * This type of axehead is practically absent from North Italy and rare in its initial area of diffusion to the north-west of the Alps, which extends up to 500 km (on average) from the jadeitite sources;
- * Most axeheads in the Altenstadt-Greenlaw corpus have been found, either as individual finds or in hoards, at distances between 500 and 1700 km as the crow flies from the source areas.

To summarise: axeheads of Altenstadt-Greenlaw and Chenoise type are essentially made of Alpine jadeitite (from Viso and Beigua, these source areas being separated from each other by 100 km). No roughout has been found in the high Alps – not even at Alba, a very important working site at mid-distance between Viso and Beigua. These types of axehead are rare up to at least 500 km from the quarries; in contrast, these remarkable objects were accumulated in considerable numbers beyond this limit of 500 km and up to the Atlantic margins of Europe. This distribution pattern is wholly atypical of the Neolithic – the only phenomenon that approaches it is the accumulation of copper objects in Denmark, the copper coming from Austria (Klassen 2000; Klassen *et al.* forthcoming a) – and which bears no resemblance to a classic ‘down the line’ circulation (Clarke 1968; Renfrew 1975).

The hypothesis that seems to us to fit the

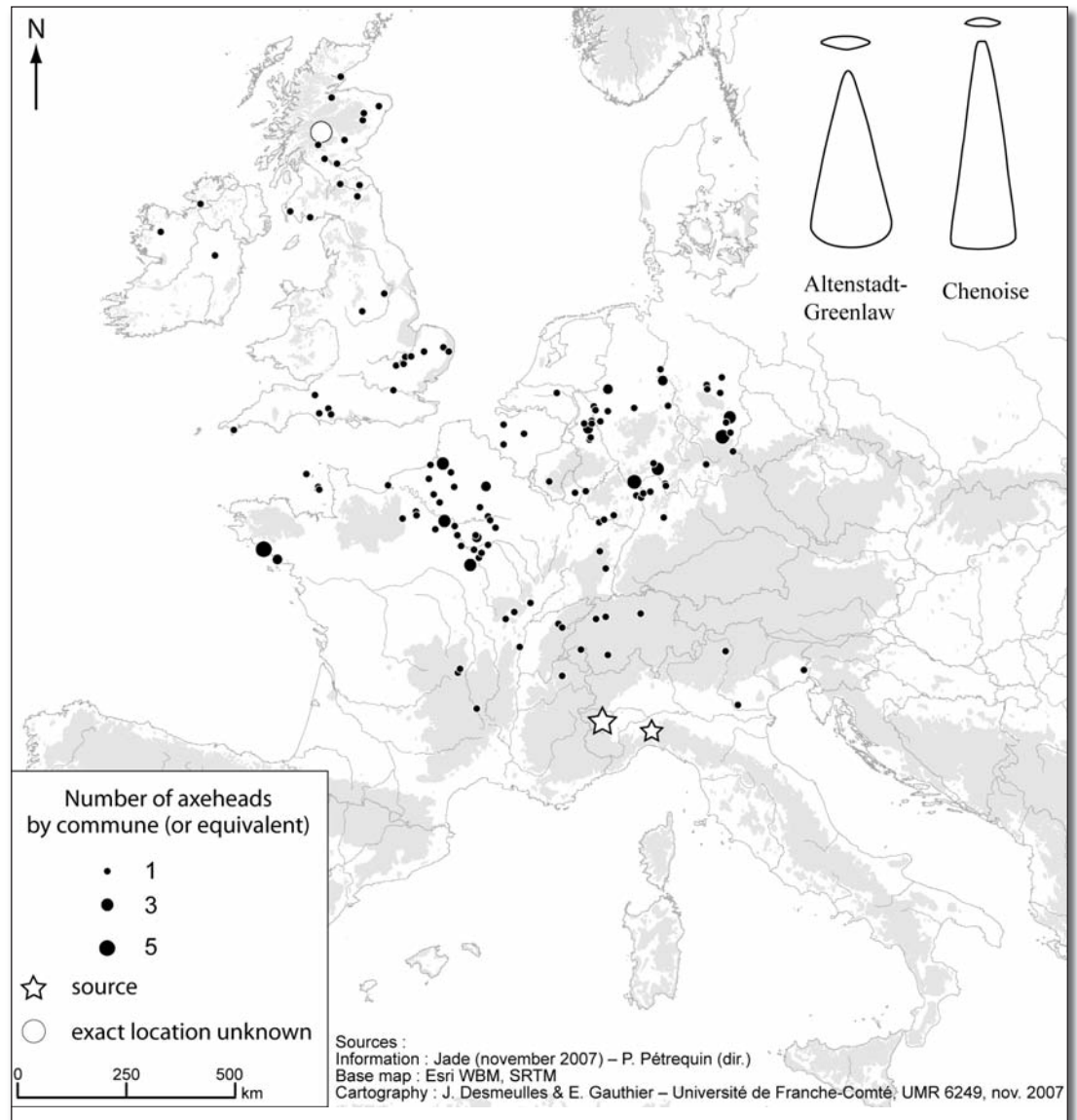


Fig. 8.

Distribution of large axeheads of Altenstadt, Greenlaw and Chenoise type, mostly of light-coloured jadeitite of Mont Viso and, to a lesser degree, of Mont Beigua.

The distribution of these axeheads, whose production took place principally during the second half of the 5th millennium, is completely different from that of Type Bégude axeheads. The frontiere between these two typological families can be traced along a line lying between Rouen and Annecy.

Cartography by
Estelle Gauthier,
using *Programme JADE*
data collected by
Pierre Pétrequin.



evidence best (but which might not necessarily be correct, after all) is based on the following observations:

- * There was no production of roughouts specifically for axeheads of Altenstadt-Greenlaw and Chenoise type;
- * Since we can be certain that these axehead types are definitely made from jadeitite from Viso or Beigua (among other possible sources), these axeheads must have resulted from the transformation of roughouts that had been created in the high Alps but which have been described, in our typology, as being of neighbouring types;
- * The only known roughout, from Lugin, is a block of Viso jadeitite that has been partly sawn in half to produce, on one side, an axehead of Altenstadt-Greenlaw type and on the other, a Durrington-type axehead. This fact allows us to recognise that these two

types are linked not only chronologically but also from a typological and technical point of view;

- * Therefore, Altenstadt-Greenlaw and Durrington belong to the same typological and technical family. This has been confirmed by the co-occurrence of the two types in the hoards at Büßleben (Thuringia, Germany) and Glenluce (Scotland), for example; similarly there are numerous isolated finds of Altenstadt-type axeheads that still show the ancient section of the Durrington type, as in the polished axehead of Römheld (Thuringia);
- * Returning to the exploitation areas in the Alps, roughouts for Durrington type axeheads, obtained from blocks by fire-setting, are very numerous. Most are of eclogite-omphacite; jadeitite examples are in the minority.

Taking these observations into account, we propose that there was an initial selection of some roughouts and axeheads of Durrington type (which had been produced at the source areas and shaped in the nearby valleys, as at Alba: Traverso 1898, 1901, 1909) by people living in the axehead-producing villages of Piedmont. This was undertaken in order to send selected examples across to the other side of the Alps, to communities who would use them both as tools and as status symbols. (By contrast, the Square-Mouthed Pottery Culture communities seem scarcely to have used axeheads as markers of status; there, short axeheads predominate, even in graves: Bernabo Brea *et al.* 2006.) A second process of selection took place at a distance of over 500 km from the source areas; this time, the particularly large and thin jadeitite specimens were singled out. A simple repolishing of the blade, in order to make it straighter, to conform with the criteria of northern axeheads (Pétrequin *et al.* 1998), would have produced an axehead of Altenstadt-Greenlaw type. In a similar manner, the Chenoise type would have been the product of a reshaping of axeheads of Puymirol type, for example. (For all these types, see Fig. 6.) This would account for the gap in the distribution of Altenstadt-Greenlaw and Chenoise type in the area between the Alpine sources and the line at 500 km to the north-west of the Alps.

This hypothesis gains support if one compares it with the situation in the Gulf of Morbihan, where a good number of Alpine axeheads, particularly in jadeitite, were thinned down and reshaped, ending up with an expanded blade and, often, with a perforation (Fig. 1). This reworking was done in order to create an original, local type, the Tumiac type. This process of transforming an Alpine axehead into a 'Carnac-type' axehead would seem to have been demonstrated perfectly clearly (Pétrequin *et al.* 1998; Herbaut 2000). Furthermore, we can strongly suggest – from the predominance of light and translucent jadeitite among Tumiac type axeheads – that these Carnac-type axeheads were made in the Morbihan by re-working Altenstadt-Greenlaw axeheads.

Thus, along the route of the long-distance transfers from the Alps to the north west, one can perceive a series of transformations of certain Alpine axeheads that were undertaken in order to respond to the desires of elites to create new forms that were original and difficult to imitate – in particular the Carnac-style axeheads with expanded blades.

A comparable ethnographic example in New Guinea may be cited: the quarries of green-schists and amphibole schists at Wang-Kob-Me were exploited by the Wano who hardly ever used these rocks to make everyday tools. Instead, they sent thin tablet-shaped pieces and very long roughouts to the Dani, who live at a distance of over two weeks' march from the quarries. The Dani then worked on the roughouts and polished them for a long time to create objects (*ye-yao*) to use in compensation payments. Further away still, the same large objects in this magnificent green stone figured among the sacred objects (*ye-pibit*) among the Yali and the Una (Pétrequin *et al.* 1993b, 2006d).

Polished axeheads of Puy type

With the Puy type of axehead, which made its appearance in Chasseen contexts at the end of the 5th millennium, it seems that Alpine axehead production was in progressive decline (Fig. 6), while the range of Alpine rocks used shows an increasing diversity (eclogite, omphacite, amphibolite, jadeitite, serpentinite, greenschists). The pattern taken by the long-distance movement of Puy-type axeheads – which includes examples found in Great Britain, which must date to the period when the flow of Puy axeheads was already retreating (Fig. 9) (Pétrequin *et al.* 2008b) – the opposition between the north (Altenstadt family) and the south (Bégude family) is at its strongest.

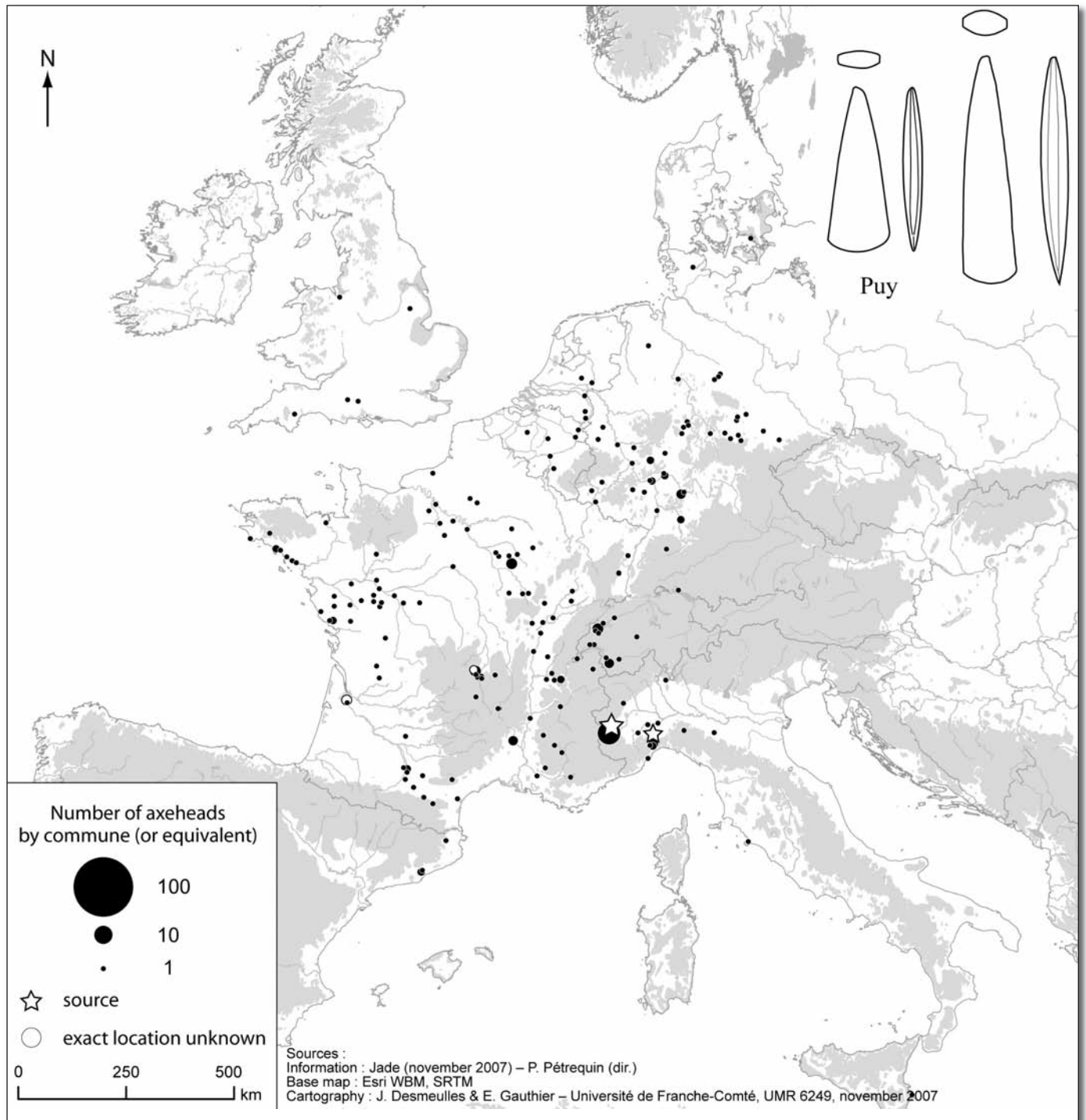
Since roughouts for Puy type axeheads are clearly present in the extraction areas of Viso and Beigua, the origin of their production (and their producers) seems to be a straightforward matter. Production probably included the movement of some raw blocks, in order to be sawn, to the region of Pinerolo (for which see, for example, the assemblage from Balm' Chanto at Roretto: Nisbet *et al.* 1987) and also to Savoie (at Sollières-Sardières, Les Balmes, Thirault 2004). At a Europe-wide scale, the distribution of these axeheads has a distinctive character: there seem to be clusters of finds, fairly regularly spread along the axes of transfer (which passed along the south of the Massif Central, the Paris Basin and the Rhine Valley). The number of axeheads does not seem to diminish with distance from the source and one can suggest, without a great risk of being wrong, that these axeheads played an important social role even though they are less spectacular-looking than the axeheads of the second half of the 5th millennium (cf. Fig. 7).

Fig. 9.

Distribution of large axeheads of Puy type, in various Alpine rocks (eclogite, jadeitite, serpentinite or amphibolite). The distribution of these axeheads, whose use lies towards the end of the 5th millennium and at the beginning of the 4th, covers most of western Europe; the previous opposition between the distribution of northern and southern axehead types (Figs. 8 & 9) has disappeared by this stage.

Cartography by
Jonathan Desmeulles
and Estelle Gauthier,
using *Programme JADE*
data collected by
Pierre Pétrequin.





Sacred axeheads

Let us return to our initial premises. There are two opposing hypotheses concerning the distribution of dark-coloured (eclogite, omphacite) and light-coloured (jadeitite) Alpine rocks in western Europe over the course of the 5th millennium and the beginning of the 4th. The first (of Pétrequin *et al.*) proposes a partial north-south opposition between these two families of Alpine rocks – one that corresponds, in all probability, to different historical trajec-

tories (i.e. population and cultures of the Danubian tradition in the north, and of the Mediterranean tradition in the south: see, in particular, Pétrequin, Cassen *et al.* 1998, 2002). The second hypothesis, belonging to D'Amico, Starnini *et al.*, tends to deny this opposition and these historical trajectories. Instead it favours a process of progressive, down-the-line type selection of jadeitite axeheads, from the Alpine source areas to the most distant users, noting that their number increases with distance from the source areas. Thus, it is through 'cultural

choice' that the rocks that are the toughest, translucent and of pale green colour (jade-jadeite) came to be selected in north-west Europe.

The results of *Programme JADE* can be used to test these two hypotheses. They show that there is some truth in both, but that neither is sufficient to account for the complexity of the dynamic of production, circulation and use of the large Alpine axeheads, or of the social processes that underlie this complexity. The general south-north opposition between dark-coloured and light-coloured axeheads has been confirmed; it is likely that this relates to different historical trajectories, linked to the establishment of Neolithic currents of movement at the end of the 6th millennium. But this opposition is equally chronological in nature, with the high point in the use of jadeite falling around the middle of the 5th millennium in Brittany and the Paris Basin (before passing on to Great Britain, Ireland and Germany), at a time when highly stratified societies had emerged. In particular, around the Gulf of Morbihan, certain individuals would have held exclusive control over religion and rituals; Alpine jade axeheads would have occupied an important place in this system of belief and practice, among other signs of power (Pétrequin *et al.* 2009).

Thus, it is due to their 'consecration' into the world of power, of the sacred and of supernatural forces that the polished axeheads, mostly of jade, achieved such a far-flung distribution, reaching 1700 km as the crow flies from their area of origin and crossing different languages and cultures on their way. (For the fullest development of this concept, see Pétrequin *et al.* 2009.) This suggests a certain sharing of ideas and of social functioning in the Morbihan, in the Paris Basin, in Great Britain and Ireland and in Germany.

The point at which the selection of axeheads – and in particular, the preferential selection of those of jadeite – was made in order to fulfil a social (religious) need came at 500 kilometres' distance from the source areas. It is for these social reasons that axeheads of Durrington type (essentially of light-coloured jadeite) were chosen beyond this 500 km point, in order to modify their form (into the Altenstadt type). Yet further away, at 1000 km from the Alps, these axeheads which no longer bore any resemblance to their North Italian 'ancestors' were once more transformed, in both shape and thickness, in order to create the famous, and in several cases exquisite, Carnac-type axeheads (in particular the Tumiatic type).

But the story does not end there. The Gulf of Morbihan region had been the epicentre, around the middle of the 5th millennium, of a new system and new vocabulary of belief, expressed in terms of stones set up to point towards the heavens, of alignments of menhirs, of stelae, carved images (Shee Twohig 1981; Le Roux 1985; Cassen 2000, 2007), gigantic tumuli and sacred objects such as the Alpine axeheads. Over the course of the second half of the 5th millennium, the influence of the Morbihan rituals began to be felt elsewhere, in the interior of Continental Europe (Cassen 2000; Pétrequin *et al.* 2006a; Klassen *et al.* forthcoming a,b) and in north-west Spain and Portugal. The Carnac-type axeheads found here and there in western Europe allow us to follow the expansion of this 'reflux movement' (*choc en retour*) as far as Germany, Switzerland and even as far as southern Italy (Zimmermann 2004) and Croatia (Petric 1995). These Alpine axeheads, which became Breton axeheads in the Gulf of Morbihan, have specific characteristics such as expanded blades or perforations close to the butt.

Along the length of this 'inverse trajectory' towards Germany and the Alps, these sacred objects were imitated in local materials (Fig. 10): flint in the case of the area around Paris (as shown in an example from Paris) and in the Sénonais (Fontaine-la-Gaillarde), linked to the extensive exploitation of mined flint; flint once more in north-east Switzerland, in Alsace and in the Pays de Bade, with Type Glis (Lausanne) (Speck 1988; Pétrequin *et al.* 1995); alpine serpentine and nephrite in Switzerland and in south-west Germany for the axeheads of Type Zug, with their perforated butt (Uerschauen) (Pétrequin *et al.* 2006a). Furthermore, elsewhere in Europe there were also copies in fibrolite in Spain and Portugal, of Type Cangas, once more with a perforated butt (Fabregas Valcarce *et al.* 1982; Cassen 2000).

Finally, there is another story that could be told about the Neolithic societies in western Europe during the 5th and 4th millennia, which concerns the use of particularly rare 'object-signs' whose significance has not been given its due importance here. The tools and the hypotheses developed by *Programme JADE* have, however, allowed us to create solid keys that can be used to unlock further secrets regarding these axeheads of alpine jades and their late imitations. They also permit us to pass beyond the traditional kind of reasoning that focuses solely on petrography and mineralogy, and to integrate the results into the world of social sciences and into issues relating to the functioning of societies.



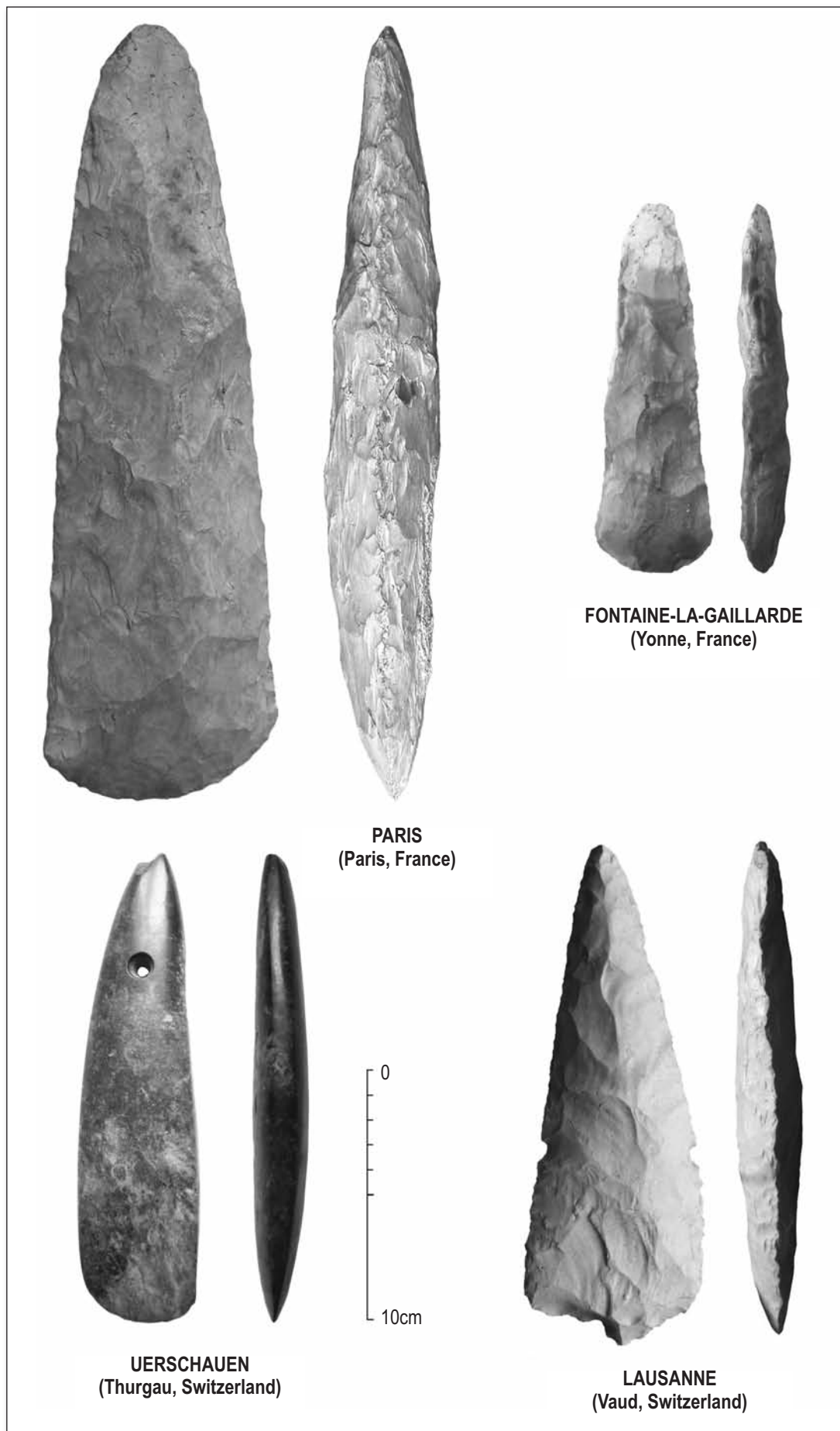
Fig. 10.

Imitations of Alpine axeheads made in local rock types. From the end of the 5th millennium, as the production of Alpine axeheads and the selection of jadeite at high-altitude source areas was on the wane, there appeared imitations in local rocks.

These copies in flint (Paris, Fontaine-la-Gaillarde, Lausanne) or in serpentinite (Uerschauen) were, above all, copies of Carnac type axeheads – that is to say, axeheads that had been repolished in and around the Gulf of Morbihan and re-injected into the transfer of axeheads back towards the Alps and towards Germany.

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■ ■ ■ Upton Lovell G2a, an Early Bronze Age Bowl Barrow in Wiltshire, excavated by William Cunnington in 1801 and known for many years as the *Shaman's Grave*. In his *Manuscript Letters* (Vol 1:15–18), Cunnington remarks on the extraordinary richness of the materials associated with two adult inhumations, an inventory that includes perforated bone points and boars' teeth, whetstones, mullers, beads, hollow flint nodules or “eagle stones”, non-local pebbles and stone hammer fragments, a bronze awl, a battle axe and a shale ring.

What makes the assemblage remarkable is the presence of four polished flint axes, three of them more or less complete. The forms suggest they were made many centuries earlier, perhaps more than a millennium before the barrow was raised. All four blades show scars of service and the damage often caused by falling out of use and out of sight; in this they resemble most of the blades recovered across the region. What sets them apart is their context, later funerary associations suggesting rediscovery, or curation across a remarkable tract of time.

Scholars still argue about the interpretation of the site. Some see the eclectic mix of artefacts as the accoutrements of a Shaman. Others point to a link with metalworking, the highlighting of a link with tasks by no means uncommon in funerary rituals at the time. The old blades work in both scenarios, talismans or touchstones for those who had the capacity to transform materials, to engage with spirits and move between worlds. ■

Photo: Wiltshire Heritage Museum, Devizes

●●● *Back then, the museum was like an extension of their house. The children had a sand pit in the garden out the back and years later, when the car park was extended, the sand was removed. No one seemed surprised to find axes from the collection in there; the kids played with them all the time. ●*



Power tools:

Symbolic considerations of stone axe production and exchange in 19th century south-eastern Australia

Abstract

The paper uses ethnohistorical evidence and other sources in an examination of the symbolic contexts of stone axe production and exchange in 19th century south-eastern Australia; providing a basis for understanding anomalies in the distribution of greenstone axes from certain central Victorian quarries. Of particular interest is the apparent link between the production and exchange of axes and cultural perceptions of landscape.

Introduction

This paper considers symbolic aspects of the production and exchange of edge-ground stone axes in historical south-eastern Australia. Edge-ground axes have an antiquity of 32,000 years in northern Australia and around 5000 years in the south-east of the continent (Morwood & Hobbs 1995). Often described as “hatchets” or “tomahawks” due to their short (<300mm) helves (Dickson 1981), stone axes were multi-functional implements used primarily for shaping wooden artefacts and removing bark and extracting food resources (eg possums, honey, and grubs) from trees (Dawson 1881; Smyth 1878). Aboriginal stoneworkers manufactured axes by percussion flaking and grinding, and in some cases hammer dressing (“pecking”), a wide range of hardstone rocks (McCarthy & Bramell 1946). These materials were obtained from both secondary geological sources (streambeds and gravel bars) and primary bedrock outcrops (Mitchell 1961). Axes made from cobbles and quarried blanks were often widely distributed from their points of origin (eg Binns & McBryde 1972). However, axes from some of the largest known quarried outcrops traveled remarkable distances across the Australian landscape, in some cases more than 1000km from source (Davidson *et al* 2005; McBryde 1987, 1997, 2000a, 2000b). The symbolic aspects of the movement of axes from the major quarries in south-eastern Australia form the main concern of this paper. Why were edge-ground axes from particular outcrops so highly

valued by Aboriginal people, and why were artefacts from certain quarries exchanged into areas with abundant sources of technologically equivalent hardstone?

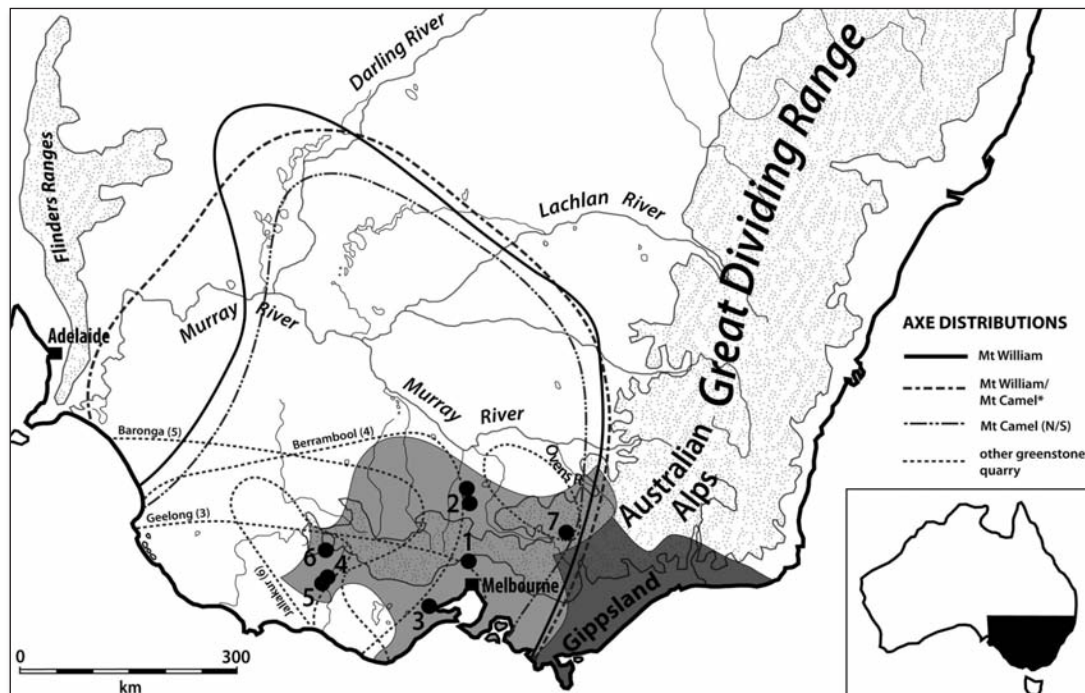
Isabel McBryde’s celebrated greenstone axe distribution study is employed as the primary case example due to the insights provided into social elements of the production and exchange of stone axes in central Victoria. A review of McBryde’s research highlights avenues for further investigation of the potential importance of stone axe technology in cultural perceptions of the landscape and the symbolic power of certain quarried outcrops in south-eastern Australia.

Greenstone axe distribution in south-eastern Australia

McBryde’s petrological analysis examined the distribution of edge-ground axes from Cambrian greenstone (amphibole hornfels) quarries in the Central and Western Belt formations of southern Victoria (McBryde 1978, 1984a, 1984b, 1986, 2000a; McBryde & Harrison 1981; McBryde & Watchman 1976; Fig. 1). Axes from these quarries were found throughout central and southern Victoria. However, those from the Central Belt quarries, Mt William and Mt Camel (North and South), were particularly widely spread, with Mt William axes found more than 1000km from the quarry (McBryde 2000a; Fig. 1). Greenstone axes from the Central Belt quarries also moved in specific, non-ran-

Fig. 1.
Greenstone axe distributions in south-eastern Australia. Greenstone quarry locations in central Victoria are shown as numbered black circles:

- 1) Mt William;
- 2) Mt Camel (N & S);
- 3) Geelong;
- 4) Berrambol;
- 5) Baronga;
- 6) Jallukar;
- 7) Howqua.



All of the greenstone quarries are located within the Kulin language/cultural area (shaded light grey); greenstone axes are statistically absent from the Kurnai language/cultural area (shaded dark grey).

Data sources: axe distributions (McBryde 1984a); language areas (Clark 1990); map base (modified from McBryde 1984a, 268 Figure 1).

*A proportion of greenstone axes from Mt William and Mt Camel overlap petrologically and may belong to either group (see McBryde 1978 for discussion).



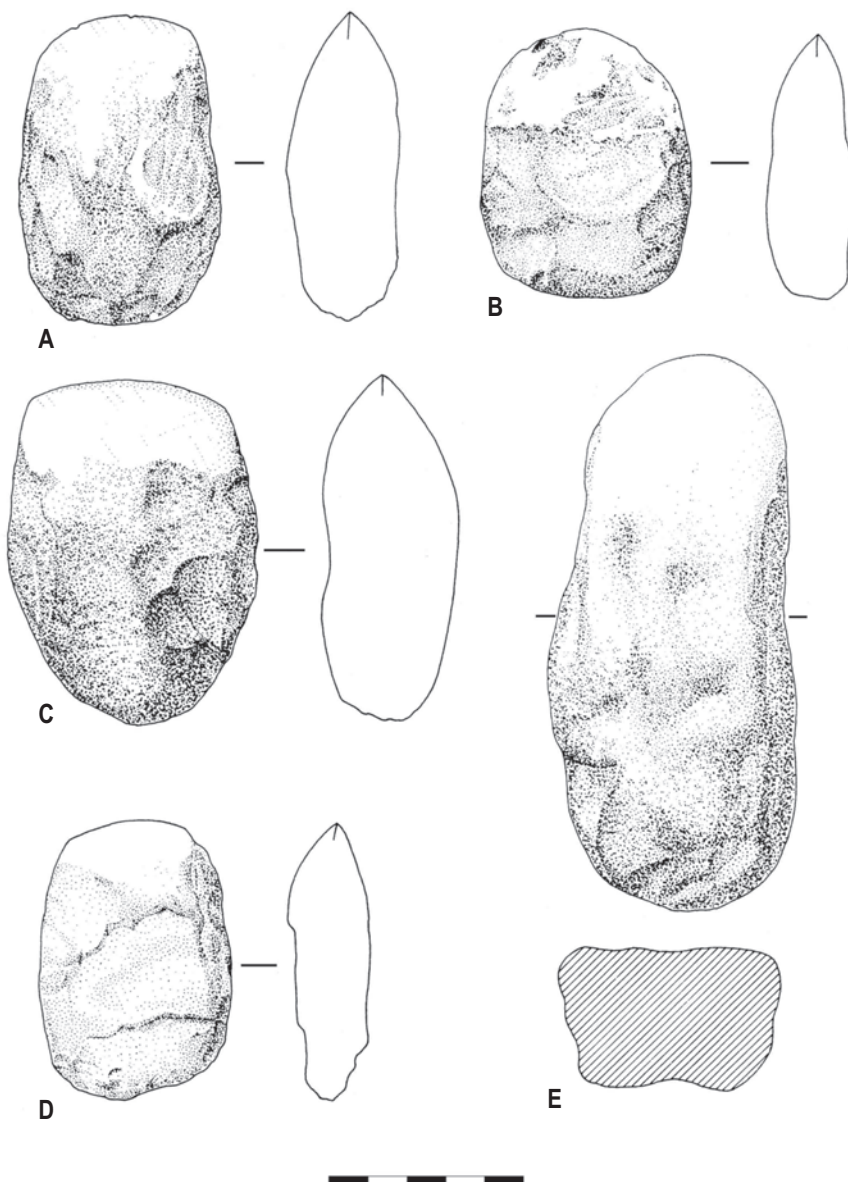
dom directions. They were concentrated in the Western Plains district to the west of the quarries and throughout the lowland areas north of the Murray River, but largely absent from the uplands of north-eastern Victoria and the Gippsland in the south-east (McBryde 1978). Curiously, greenstone axes from Mt William and Mt Camel were concentrated in areas with abundant sources of high quality basalt and dolerite and in some cases functioning greenstone quarries. These local hardstones are equally well suited to the manufacture of impact resistant edge-ground axes, yet they were not intensively exploited. The inhabitants of these regions clearly sought the exotic Central Belt axes (McBryde 1978).

McBryde's (1978) interpretation of these patterns focused on the ethnohistorical record.

There is no recorded information about Mt Camel, but the Mt William quarry was still in use in the 1830's and possibly as late as the 1850's (Paton 2005:272). The quarry was well known to early European observers as the major source of axe stone for Aboriginal people in Victoria (e.g. Anon 1855; Blandowski 1855; Batey 1886; Davis 1898; Dawson 1881; Krefft 1865; Smyth 1878; Howitt 1904; see Paton 2005 for review). Aboriginal people were known to travel great distances to Mt William quarry in order to obtain greenstone (Anon 1855; Blandowski 1855; Batey 1886). Axes from Mt William (Fig. 2) were also brought to major intergroup ceremonies and exchanged for valuables such as reed spears, sandstone grindstones, and possum skin rugs or cloaks (Smyth 1878; Howitt 1904). Even groups situated hundreds of kilometres from the quarry readily recognised the greenstone axes and could pinpoint the location of their source (Anon 1855; Batey 1886; Batey nd in McBryde and Harrison 1981:183). The ethnohistorical record, therefore, substantiates McBryde's petrological data in showing that greenstone axes from Mt William were greatly valued by Aboriginal people and circulated through long distance gift exchange networks.

Ethnohistorical sources also provide a basis for interpreting the non-uniform dispersal pattern of axes from the quarry (McBryde 1984a, 1984b). At the time of the establishment of a permanent European settlement at Melbourne in the late-1830's, Mt William and the other Cambrian greenstone quarries were situated on the traditional estate of the Kulin (Howitt 1904; Fig. 1). The Kulin "nation" was a regional cultural bloc comprising local land owning clans linked together by kinship ties and similarities in speech and religious practice (Howitt 1904; Barwick 1984:104–6). Situated to the south-east of the Kulin in the Gippsland region were the Kurnai, a linguistically distinct and somewhat isolated group (Fison & Howitt 1880; Howitt 1904; Fig. 1). In the early 19th century the Kulin and Kurnai were bitter enemies engaged in constant warfare. McBryde (1978) contended, therefore, in light of the historical situation, that the absence of greenstone axes in the Gippsland may be a consequence of the lack of social interaction between the Kulin quarry owners and certain neighbouring clans. McBryde's (1986) linguistic reconstructions for south-eastern Australia also showed that greenstone axes from the Central Belt quarries moved within language areas that shared a close genetic relationship and similar lexical items related to stone and stone axes. This sug-

Fig. 2.
Greenstone axes from
Mt William quarry (after
McBryde & Harrison
1981). Scale = 50 mm.



gests that greenstone axes were most often exchanged among groups who were interrelated socially, for example through intermarriage, and that language barriers prevented the movement of axes into certain areas. As McBryde concluded: 'In mapping changes in the distribution arrays of [axe] stone from the various major quarries we may therefore be mapping changes in the social relationships these distributions reflect' (McBryde 1984b: 151).

In sum, McBryde's petrological and ethno-historical analyses showed that greenstone axes from the Central Belt quarries, in particular Mt William, were highly prized in many parts of south-eastern Australia and are often found in areas that feature abundant sources of technologically equivalent hardstone. Why did Aboriginal people go to such lengths to obtain greenstone from the Central Belt quarries? What made the axes from these sources so special? In order to address these questions it is important to examine in greater detail the ethnohistorical information available for Mt William quarry, which provides insight into the nature of the social organisation and symbolic contexts of stone axe production and exchange in south-eastern Australia.

Mt William quarry

Mt William quarry is situated around 70km north of Melbourne (Fig. 1). Early European observers were astonished by the scale of stoneworking at the site: 'The quarries which extend over an area of upwards of 100 acres, present an appearance somewhat similar to that of a deserted goldfield' (Blandowski 1855: 56; see also Anon 1855; Davis 1898; Barnard 1907; Hall 1908; Fig. 3). McBryde (1978) recorded extensive evidence for bedrock quarrying and below ground extraction of greenstone along a one kilometre ridge at Mt William (see also Casey 1971; Mitchell 1961). These activities produced abundant (>50) flaking floors and piles of debitage up to 50m long, over 30 circular mounds of knapping debris up to 50m in diameter and one metre high, and more than 250 shallow mining pits and shafts. The chronology of Mt William is not well understood: 'The archaeological evidence indicates either a short-lived, vast economic enterprise involving a large labour force, or the agglomeration over time of many small-scale quarrying and knapping activities' (McBryde 1984a:273).

Fig. 3.
Mt William quarry.
The photograph, taken by John Henry Harvey c1906, shows a mound of knapping debris on a ridge (background) and adjacent scree (foreground).

Reproduced with permission from the State Library of Victoria
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The social organisation of Mt William quarry

It seems that no European documented the actual process of quarrying and axe manufacture at Mt William (Paton 2005). However, the nephew of the last traditional custodian of Mt William, the senior clan leader William Barak (c1824–1903), gave an account of the social organisation of the quarry to the ethnographer Alfred Howitt (1904).

At the time of European contact, Mt William quarry was situated within the traditional country of a major Kulin land owning clan, the Woiworung (Howitt 1904). The quarry was located on the border between two patrilineal groups of the Woiworung: the Gunung willam balug and the Wurundjeri willam (Barwick 1984; Clark 1990). Certain individuals from these groups were identified as the traditional owners or custodians of the quarry. The owner/managers were all senior male clan heads known as *ngurungaetas* (Howitt 1904:307). Often described as “chiefs” by European settlers (e.g. Dawson 1881:5–6), *ngurungaetas* were men of considerable power and authority within their own and neighbouring communities: ‘It was he who called the people together for the great tribal meetings, sent out messengers, and, according to his degree of authority, gave orders which were obeyed’ (Howitt 1904:307).

Billibellary was the Wurundjeri willam *ngurungaeta* and senior custodian and axe maker at Mt William quarry (Howitt 1904:311), as had been his father before him (McBryde 1984a:272). Billibellary lived at the quarry in order ‘to take care of it’ (Howitt nd, 37 cited in McBryde 1984a:271). Neighbouring groups wishing to obtain greenstone axes contacted Billibellary and met him at the quarry grounds. Here, according to strict protocols, they exchanged goods (e.g. possum skin rugs) for greenstone (Howitt 1904:312).

Clan heads and “songmaking”

The position of *ngurungaeta* was an inherited title that most often went to the eldest son or nearest male relative of the previous *ngurungaeta* (Howitt 1904:308; see also Dawson 1881:5–6). First, however, the candidate had to demonstrate their worthiness for such a prestigious role. This was most often done through personal charisma, fighting prowess, and oratorical skill. In the case of the latter, “songmaking” abilities appear to have been particularly important.

Woiworung “songs” communicated religious knowledge in the form of songs, myths, stories, and ritual song and dance performances (called “corroborees” by early European observers) (Howitt 1887, 1904). As Howitt (1887:328) noted: ‘The songs are very numerous, and of varied character, and are connected with almost every part of the social life’. Songmakers were held in high esteem: ‘Their names are known to the neighbouring peoples, and their songs are carried from tribe to tribe, until the very meaning of the words is lost as well as the original source of the song’ (Howitt 1887:329). Howitt (1887:329) recorded the movement of one song a distance of more than 800km from its source (see also Dawson 1881:80).

According to Barak, the most powerful *ngurungaeta* of the Woiworung was Old Ningulabul, a renowned songmaker of the Gunung willam balug from the Mt Macedon region (Howitt 1904:310–11). Old Ningulabul was descended from a long line of famed songmakers (Howitt 1887:330). His sons were also eminent songmakers with key roles in the ownership of Mt William. Their prestige as Billibellary’s “messengers” was such that they were able to travel through distant clan lands in safety (Barwick 1984:121). Old Ningulabul exerted ‘paramount religious authority’ in the region (Barwick 1984:121). His rights in the ownership of Mt William quarry were also held by Barak to be the most important of all: ‘[Old Ningulabul] took care of the stone quarry whence tomahawks were procured. He took care of it for all the tribe (Woiworung). Hence he was called Ningulabul = stone tomahawk’ (Howitt nd, 34B cited in McBryde 1984a:272). It was he who appointed his sister’s husband, Billibellary, *ngurungaeta* of the Wurundjeri willam (Howitt 1904:310–11).

Songmaking and control of resources in Aboriginal societies

In certain northern and central Australian Aboriginal societies the present is lived and understood in ways that draw continual reference to the events of the creationary epoch, or Dreaming (Keen 1994; Morphy 1989, 1991; Myers 2002). The laws of nature and humanity set into place by Ancestral Beings during the Dreaming are considered immutable; they determine the pattern of human existence. However, precise knowledge of the Ancestral past is often acknowledged by senior religious figures to be incomplete (Keen 1994, 2003, 2004; Tonkinson 1991). Accordingly, new insights into



the ambiguous actions of Ancestral Beings may occasionally come to light through the dreams and other revelatory experiences of individuals whose knowledge of religious matters is unquestioned (e.g. Keen 1994, 2003; Layton 1998; see also Tonkinson 1991, 2003). Such information is perceived as preexisting knowledge that is selectively revealed by the Ancestral world, rather than initiated by humans. The revelations quite often involve new understandings of certain key natural resources within the landscape, such as productive hunting grounds or useful stone outcrops, and take the form of songs, myths, dances and ceremonies concerning the creation and meaning of these places. If accepted by others – and so long as they do not deviate too far from conventional understandings – the new forms will be incorporated as congruent layers of meaning into the existing corpus of religious knowledge (Layton 1998). Consequently, the innovators must be consulted and/or compensated by those wishing to use the resources in question (Keen 2003). In this manner, creative reinterpretation of ideologically fixed beliefs provides particularly knowledgeable individuals with opportunities to exert control over collectively owned resources whilst denying complicity in the innovation of new elements (Bell 1983:92). The inevitable outcome of this, as Keen contends in relation to northern Australia, is that ‘the parts of country richest in...resources were associated with the most important...ancestors, sacred objects, and ceremonies, suggesting that people have long attempted to anchor control of resources in ancestral identity and religious practice’ (1994:291).

There are potential parallels here with Victorian Aboriginal societies of the early 19th century. Songs were integral to Kulin societies and songmakers were held in great esteem, their songs communicated from clan to clan for hundreds of kilometres (Howitt 1904:413). Songmakers were individuals whose knowledge had the potential to reach and influence a far wider audience than their immediate family group or clan. Woiworung songmakers were also seen as having no creative role in the composition of songs: ‘It was said that the person who sang it got it from his grandfather, who got it from his parents, who got it from the old people, who got it from [the Ancestral Being] Bunjil’ (Howitt 1904:418). Woiworung informants told Howitt (1887:330) that songs came to songmakers in dreams, often from deceased relatives, or ‘because the power of Bunjil “rushes down” into the heart of the singer’.

A careful consideration of the role of ngu-

rungaeta in controlling and promulgating knowledge about the power of stone axes and quarries in Aboriginal belief systems sheds interesting light on the complex symbolic dimensions of axe production and exchange in central Victoria.

Places of power in the landscape

Kulin songs and myths often concerned the symbolism and meaning of certain landforms and geological features within the landscape of major significance for surrounding groups (Massola 1961). Kulin myths describe the principal Ancestral Being, Bunjil, as having undergone a series of journeys across the formless Victorian landscape during the creationary epoch – sometimes in the form of a star – creating the rivers, creeks, mountains and valleys by carving up the earth with his large stone knife (Thomas nd:86, 88) or ‘flint’ (Robinson 1841 in Clark 1998a:324). Other mythological figures, such as the giant, Lohan, are said to have made similar creationary journeys (Ellender 2002; see also Howitt 1886). At certain places in the Victorian landscape these entities rested or performed some notable activity and these became sites of deep religious significance for Aboriginal people. Bunjil, for example, as he journeyed along the southern Victorian coast at Cape Schanck near Melbourne, is said to have made the rocky outcrops at this place emerge from the sea and form a cave in which he sheltered from a storm (Howitt 1845:147–8). Another myth describes Bunjil, in great anger, forming a cave in the region by causing a star to fall down from the sky and open a chasm in the rock (Massola 1957:19). Often these places were believed to resonate with the (sometimes dangerous) power of the supernatural beings that created and/or inhabited them. For instance, the area at Western Port Bay where Bunjil terminated his journeys was ‘hallowed ground’ to the Woiworung (Barwick 1984:115). The land adjacent to Lohan’s resting place at Wilson’s Promontory was ‘bad country’, and complex ritual knowledge was required to enter it safely (Barwick 1984:115; Ellender 2002; Howitt 1904). A granite mountain (Mt Buckrabanyule; see Massola 1969:42) situated 230km north-west of Melbourne was considered by Kulin peoples to be the home of Mindye, a profoundly feared snake-like being under the command of Bunjil; it was believed that anyone approaching this area would immediately sicken and die (Thomas nd:89; see also Robinson 1840 in Clark 1998b:204).



Similarly, a mountain (Warmum) in the Great Dividing Range at the headwaters of the Yarra River was believed to be one of the resting places of Bunjil: 'whoever looks on this mountain direct will first be struck blind, and then dead; no one can look at it and live' (Thomas nd:91; see also Fison & Howitt 1880:210). Another peak (Narn) in these ranges was the home of a malevolent stone spirit: 'The [Kulin] will not visit this range' (Smyth 1878:455).

Importantly, certain powerful individuals and groups were recognised as owning or being otherwise responsible for the ritual knowledge of these sites and, in some cases, the control of the associated supernatural force. Thomas noted that individual mountains within the Upper Yarra ranges, including the dangerous Narn, each had their own custodians: senior Kulin clan heads and renowned songmakers or 'doctors' (ie religious specialists) (Wesson 2001: 16–17). It was also believed that only senior members of a specific Kulin clan (the Munnie Brumbrum) who lived in the vicinity of Mindye's mountain were able to summon and/or mitigate the power of this being (Smyth 1878:445–6). Thomas described these individuals as 'possessing great power' (Thomas in Smyth 1878:445). Old Ningulabul is said to have been responsible for the custodianship of certain 'sacred sites' near Gisborne at the southern end of the Macedon Ranges of major significance to many Woiworung, Jajowrong and Wathaurung groups (Barwick 1984:121).

It seems relevant, therefore, given the power of religious knowledge to shape (and reshape) Aboriginal societies, that strict control of Mt William quarry was exercised by a group of closely interrelated songmakers and ngurungaetas with central roles in the communication of knowledge (songs) about symbolically charged places in the landscape. As Hodder (1992:87) argues: 'Power over others through the control of material resources has to be linked to the valuation, prestige and knowledge allocated to those resources'. What was the role of stone axe technology and indeed, Mt William quarry, in south-eastern Australian myths and oral traditions, or song?

Stone axes in myth

The evidence for south-eastern Australian mythological beliefs is very fragmentary. Some myths were recorded in relative detail by 19th century observers (e.g. Stanbridge 1861; Smyth 1878; Howitt 1904), but it is clear that many were not. Moreover, some extant myths may be

relatively "open" versions of narratives that once contained levels of detail and meaning now lost. However, surviving elements provide some insight into the symbolic importance of stone axe technology in south-eastern Australian belief systems.

Myths involving stone axes often concern the activities of powerful Ancestral Beings and other, often dangerous, supernatural forces. For example, an oral narrative from north of the Lachlan River describes the greatly feared spirit, Yandhangga, as having a stone axe protruding from his right elbow with which it killed humans and other game (Mathews 1905:155) – such beliefs appear to have been widespread: when Aboriginal people near Spring Creek first encountered a European bullock they believed it to be a Muuruup spirit with stone axes (horns) growing from its head, which they eagerly sought (Dawson 1881:105–6). A Kurnai myth accounting for the origin of the moon portrays it as a ravenous being that greedily devours the Ancestral eagle, whose wives then kill it with their stone axes (Smyth 1878:432). A Wangkangurru myth recorded by Howitt (1904:652) describes the preparations made by two important Ancestral Beings for the initiation of their sons as involving the sharpening and hafting of stone axes for making various ritual objects.

The most compelling myths concern the role of stone axes in the formation of certain salient features of the south-eastern Australian landscape by noted Ancestral Beings. For example, an important waterhole in a granitic rock formation near Byrock in central New South Wales in Ngemba mythology is believed to have been created by Baiame – like Bunjil, a principal Ancestral Being of south-eastern Australia – who 'dug the water hole with his stone hatchet, and everytime it became blunt during the operation, he whetted it on the surface near him' (Mathews 1905:138). In a Western Kulin narrative, an Ancestral Being smashed open the head of another using a stone axe, the subject of an unsatisfactory gift exchange between them (Massola 1962:110; Massola 1968:29; see also Stanbridge 1861:300 for an earlier version). The axe wielding Ancestral Being subsequently transformed into Mt Buninyong, a prominent extinct volcanic cone (700m above sea level) on the flat Western Plains near Ballarat. The mortally wounded Ancestral Being fled towards the south-west and transformed into Mt Elephant, a steep scoria cone with breached crater rising 200m from the surrounding volcanic plain. The distinctive shape of Mt Elephant, visible more than 60km away, results from the axe inflicted



wound. In another myth from this region a prominent cobble bar beneath wave cut basaltic cliffs on the north-western shores of Lake Burrumbeet near Ballarat is said to have been formed from the stone axes of people killed by a local spirit; these axes were used by vengeful relatives to destroy the spirit (Massola 1962: 111–12). Finally, in a myth attributed to Billibellary, the stone axes of two Woiworung creationary figures were used to dig up the earth and form the various channels and tributaries of the Yarra River, leading to the creation of Port Phillip Bay (Massola 1968:58).

The power of Mt William quarry

The evidence from Aboriginal myths, whilst incomplete, seems to hint at the importance of stone axes in the creation of the Kulin landscape by powerful Ancestral Beings. So is this the reason for the significance of Mt William: the embeddedness of the quarry in Aboriginal understandings of the creation and meaning of the central Victorian landscape? Certainly, there are notable examples from elsewhere in Australia (where the ethnographic record is more detailed) of the symbolic association between Ancestral power and certain quarried stone outcrops (Brumm 2004). In central and northern Australia, for example, certain tool stone sources are believed to be the transformed bodily matter (e.g. flesh, blood, fat, pus, internal organs) of Ancestral Beings deposited onto the landscape during the Dreaming and metamorphosed into rock (Brumm 2004; Taçon 1991). Beliefs about these quarries are complex. It is often said that the raw lithic materials resonate with the life force of the Ancestral Beings that created them, while tools made from them are particularly potent as they have ‘in effect, been consecrated from the time of their creation’ (Akerman 1995:48). To cite one particularly well known example, quartzite at the renowned Ngilipitji blade quarry in Arnhem Land is believed by Yolngu people to grow in the ground like a living thing and to become ‘pregnant’ with ‘baby stones’ or ‘eggs’ (Jones 1990:27; Jones & White 1988).

The greenstone at the Central Belt quarries, particularly that at Mt William, may have been perceived in a similar light, as a substance imbued with the power of the supernatural force that created it. For this reason, perhaps, greenstone axes from the quarry were so eagerly sought and symbolically valued in south-eastern Australia, even by far distant groups. Accordingly, it seems apparent that the

Woiworung ngurungaetas, as both quarry owner/managers and influential *songmakers*, must have had a crucial role in the conception and/or continued reproduction of such beliefs. They not only controlled access to the quarry and its technical organisation but also the very knowledge outlining the symbolic significance of Mt William in Aboriginal belief systems. This suggests that individuals like Old Ningulabul and Billibellary were the knowing, central figures in the vast greenstone axe production and distribution network in central Victoria. That is, they were members of a closely knit political hierarchy whose privileged status came from their ability to make Mt William axes seem more symbolically powerful than those from technologically equivalent sources. As noted above anthropological evidence suggests that in Aboriginal societies where a group’s store of religious knowledge is in the form of oral traditions the most important power base of all was control of the ideology for resources, ideas about axes.

With these points in mind it is important to examine a final piece of ethnohistorical evidence that underlines this point and further highlights the complexity of the symbolic contexts of axe production and exchange in central Victoria.

The falling sky

Howitt (1884:186) recorded the Kulin belief that the sky was a dome propped up by poles resting ‘somewhere in the mountains in the north-east of Victoria’. If the poles should fall, it was said, the sky would collapse and the clouds would burst, releasing their water and drowning everyone. Concerning this notion, Barak recalled the following incident to Howitt:

Before the ‘white men came to Melbourne’ a message was passed from tribe to tribe, until it reached the Wurunjerrri[sic], that the props were becoming rotten, and that unless tomahawks were at once sent up to cut new ones, the sky would fall and burst, and all the people would be drowned... A similar message reached the Wiimbaio, having been passed from tribe to tribe down the Murray River. It was to the effect that the props were becoming rotten, and that unless some tomahawks were sent at once the sky would fall and kill every one (Howitt 1904:427).

The same message also reached the Wathaurung Kulin, as recorded by William



Buckley (1780–1856), an escaped English convict who lived among the Wathaurung on the Barwon River near Geelong from 1803 to 1835 (Anon 1911; Billot 1979; Morgan 1852). Buckley wrote:

[The Wathaurung] have a notion, that the world is supported by props, which are in the charge of a man who lives at the farthest end of the earth. They were dreadfully alarmed on one occasion when I was with them, by news passed from tribe to tribe, that unless they could send him a supply of tomahawks for cutting some more props with, and some more rope to tie them with, the earth would go by the run, and all hands would be smothered (Morgan 1852:57).

According to Buckley, many axes and other items, including metal tools (eg iron axes and saws) stolen or scavenged from distant European settlements, were hurriedly accumulated by the Wathaurung and passed from group to group towards the place where the props that held up the sky were believed to rest (Anon 1911; Langhorne 1837; Morgan 1852).

Massola (1968:105) identifies the north-eastern mountains where the props were said to be positioned as the Australian Alps (see Fig. 1). This vast (c150,000km²) wilderness of undulating topography and 2000m alpine summits contains the highest ranges and peaks in mainland Australia (Flood 1980). It may well have seemed like the farthest end of the earth for many lowland Aboriginal groups. The Alps are also the source for the Murray River and its tributary the Ovens River. The first recorded instance of the falling sky message comes from the headwaters of the Ovens River (Massola 1968:105) and the message was spread down the Murray River and its southern tributaries into Kulin country and beyond (Howitt 1904:427).

Little is known about the groups inhabiting the Australian Alps at the time of European contact (Helms 1896; Howitt 1904; see Flood 1980 for review). However, the Assistant Protector of Aborigines William Thomas was present at a major religious ceremony at Merri Creek in 1840 that was attended by over 150 people from a distant group of the Lower Goulburn River and Buffalo River area in the northern foothills of the Australian Alps (Howitt 1904:718; Smyth 1878:136–7). The aged ngurungaeta of this group, Kallakallap, was enormously respected by all those attending. At sunrise the Kulin gathered around him and heard him speak, but when Thomas joined the audience the old ngurungaeta refused to continue. After Kallakallap's

people had left the meeting Thomas asked Billibellary, who was present, what the revered clan head had said:

He said that [Kallakallap] had informed them that there was a race living in the Alps who inhabited only the rocky parts, and had their homes in caves; that this people rarely left their haunts but when severely pressed by hunger, and mostly clung closely to their cave-dwellings; that to this people the Australians were indebted for corroborees; that corroborees were conveyed by dreams to [Kallakallap's] people and other Australians; and that the men of the caves and rocks were altogether superior to the ordinary Aboriginal (Smyth 1878:137).

An early drawing by Barak (see Sayers 1994:18) depicts the 1840 Merri Creek ceremony and what is interpreted by Cooper (2003:29) to be Kallakallap as an enormous cloaked figure addressing a large group of seated people. Some 21 hafted stone axes appear to have been placed on the ground as gifts around him. Two cloaked figures standing below the figure grip hafted stone axes in each hand. The precise meaning of Barak's drawing is unclear. However, it is a convincing depiction of the great significance of Kallakallap and his account of the Australian Alps people, along with the apparent symbolic role of gifts of stone axes in these proceedings.

So what are the implications of the “falling sky” incident? The accounts of Barak and Buckley suggest that the belief that the sky was supported by props located in the Australian Alps was common in south-eastern Australia. So too was the conviction that many gifts of stone axes were needed to maintain the props in times of crisis – in effect, stone axes kept the sky from falling. Thomas's account also implies that there was a widespread belief among the Kulin that a group of people (possibly apocryphal) lived in the Australian Alps where the props that held up the sky were located. These individuals reportedly communicated the songs and ceremonies of Aboriginal people through dreams to intermediaries such as Kallakallap's people. The residents of the Australian Alps may have been seen as the rightful custodians of the mountains in which the props rested or the only beings able to communicate with and/or placate the supernatural force in charge of maintaining them. Alternatively, clans living in the northern foothills of the Australian Alps, such as Kallakallap's people, may have served these roles. Barak's painting hints at the possibility



that Woiworung people made many gifts of stone axes to this revered ngurungaeta whom they believed to be in communication with the alpine songmakers. In any case, the potential role of the Australian Alps in the symbolic meaning and power of stone axes and the movements of these artefacts across the landscape seems compelling. Above all it is the *supply* of axes demanded by the supernatural being that is significant, as Buckley himself seemed to imply: ‘a tribute of this description is paid whenever possible: but who the knowing old juggling receiving thief is, I could never make out’ (Morgan 1852:59).

The falling sky incident highlights the possibility that large scale production of stone axes and/or the flow of axes across the landscape in south-eastern Australia may often have been motivated by religious concerns rather than the perceived social or economic benefits derived. Seen in this context, it is difficult to reconcile the image of Billibellary or the other Mt William quarry owner/managers as the knowing figures at the centre of the vast greenstone axe production and exchange system if they were often motivated to make axes to keep the sky from falling.

Conclusion

The aim of this paper has been to examine symbolic aspects of stone axe production and exchange in the historical period in south-eastern Australia. McBryde’s archaeological and ethnohistorical research shows that greenstone axes from the Central Belt quarries in central Victoria, in particular Mt William quarry, held special values for Aboriginal people that cannot be appreciated from straightforward technological or economic perspectives. In interpreting this pattern this paper considered the social and symbolic significance of stone axe technology in Aboriginal belief systems of early 19th century south-eastern Australia and the place of Mt William quarry.

Surviving Aboriginal myths point to complex cultural meanings for stone axe technology in south-eastern Australia. Stone axes appear to have had particularly important roles in cultural perceptions of the supernatural power and meaning of the Victorian landscape. During the creationary epoch Ancestral Beings such as Bunjil and Lohan made epic journeys across the Victorian landscape, infusing certain localities with power. These were places of great cultural significance to Aboriginal people (“sacred sites”), and certain individuals and/or groups were held to be responsible for their custodian-

ship. Mt William quarry may have been one such place. Indeed, it seems relevant that the most senior of the Woiworung clan leaders responsible for the custodianship of Mt William quarry at the time of European contact were renowned songmakers. These powerful and influential figures controlled the religious knowledge for the quarry and, hence, ultimately determined its significance for others. Accordingly, it is possible to argue that Mt William axes may have been so symbolically important because the Woiworung songmakers who owned the quarry were most effective at imbuing it with particular eminence in the cultural perceptions of local and far distant Aboriginal clans. Mt William axes might have been akin to ‘pieces of places’ (Bradley 2000:96) embodying the profound meanings of the quarry in shared understandings of the storied landscape (McBryde 2000b).

This is not necessarily to imply, however, that the quarry owner/managers were knowingly, and cynically, perpetrating some sort of elaborate ruse through their manipulations of widely held religious beliefs. The falling sky incident highlights the highly complex nature of symbolic beliefs about axe technology in south-eastern Australia and the role of axes in the continued maintenance of the universe. The supernatural being believed by many Aboriginal people in south-eastern Australia to keep the sky from falling did so by using stone axes to maintain the props positioned in the Australian Alps. Certain individuals and/or groups, in turn, such as those dwelling in or near the Australian Alps, may have been seen as responsible for communicating with and placating the force that kept the sky from falling. Indeed, their potential role in the distribution of axes in Victoria is intriguing. The actions of these individuals or groups may have meant that even the most senior owner/managers of Mt William were often compelled to send stone axes from their quarry into the Australian Alps to propitiate the profound force. In any case, the falling sky incident suggests that power and knowledge accrued by ideological control of resources like Mt William quarry are likely to have been contested and subject to complex considerations.

What emerges from this evidence, above all, is an image of stone axe production and exchange in 19th century south-eastern Australia – and possibly earlier – that emphasises the importance of cultural perceptions of landscape and symbolic understandings of axe technology in the spatial movements of axes and the differing values of technologically equivalent hardstone sources.



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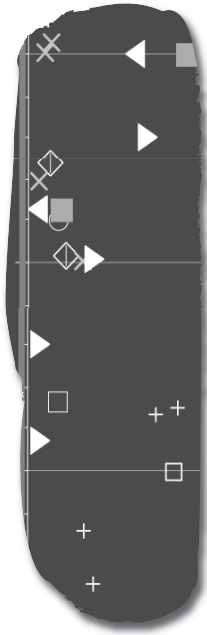


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Social and economic organisation of stone axe production and distribution in the western Mediterranean

Abstract

The question of social value is central to the study of stone axe distributions. This paper argues that a dialectical approach to the concept of value, seen as a consequence of the interplay between material constraints, social institutions and individual strategy, is essential for our understanding of prehistoric value systems. With this argument established, the paper goes on to analyse the social value of stone axes on the Northern margins of the Western Mediterranean.

The growing number of petrographic and archaeological studies undertaken during the last decade or so, mean that we can to begin to define the spatial and temporal patterns of axe production and circulation from the Alps to the Sierra Nevada during the 6th to 3rd millennia BCE. This suggests that next to regional supply strategies, long distance exchange networks developed and became the target of political control at particular times and places. However, the economic importance of these exchange relations remained relatively limited, and did not always go hand in hand with the centralisation of power. Expanded exchange could just as well serve as a mechanism to strengthen social bonds in societies where we observe an increasing division of tasks in the economic sphere.

In general, the prehistoric axe distribution patterns of the western Mediterranean, despite their rather uniform appearance, seem to be a consequence of different forms of social organisation and value systems.

Introduction

During the last two decades a growing body of petrographic analysis of stone axes has been presented by different research projects in Italy, France and Spain. The characterisation of hundreds of artefacts has provided detailed information about the range of rocks used by later prehistoric societies in different regions. Moreover, a series of spatial and temporal patterns have been proposed in relation to the circulation of different raw materials from the 6th to the 2nd millennia BCE (Ricq-de Bouard 1996; Orozco-Köhler 2000; Thirault 2005; Risch & Martínez 2008). These results make it possible for the first time to compare the different regional and inter-regional situations between the Alps, the Pyrenees and the Betic range, which constitute the three large orogenic formations that characterise the northern side of the western Mediterranean.

However, our understanding of the social and economic structures behind the observed spatial and temporal patterns is still too limited. We need to move beyond the dominant “petrographic focus” and pay greater attention to other environmental and social dimensions of axe production, distribution and consumption.

An environmental approach is necessary in order to achieve a better understanding of the areas of raw material extraction as well as the properties of the selected rocks. Both aspects represent *natural constraints* to stone axe production and require a slightly different methodological approach than so far followed by previous researchers. On the other hand, the analysis of the *social dimensions* of axe circulation not only compares the objects and their contexts of production and consumption, but judges the differences found in terms of economic, ideological or political categories that are considered to be historically significant. The criteria for such comparisons and judgements derive from a theoretical discussion that inevitably leads to the concept of *value*. Ultimately, the interpretation of the quantitative data, such as the distance and volume of circulation of materials, and the qualitative information, such as shape, texture or colour of the artefacts, will depend on the *value theory* one implicitly or explicitly uses.

Value theory and archaeological interpretation

At least since Aristotle (336–323 BCE), the idea of economy has been linked to the concept of

use value. Only those activities that provide useful things should be considered as being of value in a society. For Aristotle, the primary source of wealth was land, which allowed the development of agriculture and husbandry. His critique of trading or *crematism*, as an uncontrolled and illegitimate way to increase wealth separated from economy proper, prevented him from acknowledging the importance of the production processes and of exchange in the formation of social value. Only much later, Adam Smith (1776) proposed that *exchange value* as opposed to *use value* had to be related to the human labour invested in the manufacture of a given object. Ricardo (1817) elaborated this theory of classical economy until the analytical reduction of exchange value to the amount of labour that could be measured in units of time, incorporated in a given product, was achieved. Marx (1867) insisted on the dialectical relationship existing between such an *exchange value* and the *use value* in capitalist economy, thereby establishing the conceptual unity between production and consumption. Moreover, he was the first to fully acknowledge the importance of the means of production in economic development (*constant capital*), as a factor separated from labour force (*variable capital*) but with a direct repercussion on the value of all products in a society. By the end of the 19th century, but mainly in the 20th century different economists, such as Georgescu Roegen (1971), had in a certain way reassumed an *Aristotelic* view of economy by insisting on the necessity of considering natural resources and their exploitation as an inextricable part of the value of all goods. The awareness of the natural limits of economic development draws attention to the sustainability of the modern economic system, as well as towards questions about the control and management of the resources by different social groups at a global scale.

Meanwhile, the dominant academic thought since the end of the 19th century, known as “marginalism”, has in practice abandoned the search for a definition of value as something different from price. The concept *marginal value* considers only the relative differences between commodities resulting from a comparison between their “scarcity” and the “unlimited necessities” of the individual (Menger 1871). As the only objective expression of this comparison is the actual price of commodities, the theory is inevitably tautological and frees economic analysis from considering the material as well as historical conditions in which production takes place.¹ Modelling market behaviour in a neutral and ahistorical space, where individuals



interact under supposedly equal conditions, allows for the application of quantitative methods that confer a “scientific touch” to the analysis, but reduces the possibility to consider, for example, the ecological limits, the existing distribution of private property or unequal technological development in the world economy.

The *marginalist* reduction of the notion of value to the realm of subjective desires and necessities encouraged social scientists to drive the discussion on value into the field of the multiple ways individuals judge their relation with others (Simmel 1900; Appadurai 1986; Humphrey & Hugh-Jones 1992), or to abandon the concept altogether in the conviction that it is impossible to find an easy analytical definition for it. In either case, the dominant trend of “theoretical archaeology” during the last years has been to avoid as far as possible social or historical explanations concerned with the material, environmental and technical constraints of production and consumption, and of social reproduction in general. Even the fact that any power relation must be sustained by some form of economic exploitation and unjust distribution of property, is eluded or deluded. Concepts such as prestige, status or agency, or the ephemeral moments of exchange are much better suited for an in-material view of individual relations and thus a projection of our own values onto the past. Exchange and consumption are often treated as social entities in their own right, independent of the physical conditions – matter and energy – which make them possible, and the social needs they serve. In other words, these discussions are more concerned about the desires and value notions of the individual actors, than about the production and distribution of social values among society, i.e. the social relations of production. It is striking however, that another part of archaeology, which may be seen by some as theoretically less concerned, devotes considerable efforts to a better understanding of technology, function and the social implications of production processes (e.g. Roux & Corbetta 1989, Vidale 1992, 2002; Petrequin & Petrequin 1993; Clemente *et al.* 2002; Longo & Skakun 2008).

The heuristic importance of the notion of social value lies precisely in the fact that its meaning, according to Marx (1867/1962:49–98), emerges from the interplay between production and consumption, between objective material conditions and personal desires, between the power to impose certain economic constraints and the attempts to overcome them. The distinction between an *exchange value*, determined by the production process and most of all the

labour force, and a *use value*, expressing the subjective as well as objective perception of the qualitative properties of all goods, underlines the dynamic nature of value systems and hence their historical specificity (Lull 2002:304ff.). It also explains the dialectical construction of value through the interplay between social forces and particular interests. In other words, it unveils, at the level of the specific object and action, the fundamental distinction as well as unity between social production and individual consumption, which perpetually organises the reproductive cycle of human society (Marx 1857–58/1973:84–111). If this cycle, and the very existence of society is negated, as liberals have claimed for a long time, it is no longer possible to approach the question of surplus production and social exploitation otherwise than in purely subjective terms.

The main theoretical difficulty however is that the concept *exchange value* of Ricardo and Marx is only relevant in a market economy, where all products have become commodities (Gregory 1982). In order to overcome this historical specificity but at the same time to maintain the notion that social objects imply an intentional energetic and material transformation, we have chosen the concept of *production value* (Risch 2002:28–31). It implies that all objects/subjects generated and maintained by a community have a value resulting out of a production process that puts into action specific forces and materials. In this sense, it is not only the social objects but also the actions that generate and maintain them that must be considered as valuables (Graeber 2001:45ff.). The dialectical relation between *production value* and *use value* can be expressed by the term *social value*, as the ever-changing synthesis between production and consumption processes.

Another difficulty faced by any value theory remains the definition of the criteria needed to compare and judge social materiality. Such a request stands in the tradition of economic theory outlined above, rather than in line with post-modern reflections about the value perceptions of people in the past or the present. Its initial and principal target is to understand how economic wealth is generated and distributed inside a society. Even today, most of this process remains obscure to large parts of society, a situation that can well be defined as the “economy of suspicion” (Groys 2000). This lack of distinction between an economic analysis of value, on one side, and the interpretation of economic values, on the other, explains to a large extent the confusion generated by present debates in anthropology and archaeology.

The development of economic theory shows that it is probably a mistake to try to reduce any notion of value to one single economic factor, such as labour force. Basically, it can be proposed that *production value* depends on a series of natural and social constraints:

- * *Access to natural resources.* As this accessibility can be limited naturally as well as socially, the value of raw materials and hence of the final products certainly depends on the environmental and social conditions in which their exploitation takes place. Situations of autonomy as opposed to dependency, of unrestricted access as opposed to monopoly, or of competition versus sharing have different effects on production as well as on consumption.
- * *The production process.* Labour force, understood in an energetic sense, is an abstraction of the human implication in any economic activity and at the same time the immediate physical limit all societies are faced with. Therefore, the amount of labour force devoted to a specific production necessarily effects the production value of the generated objects or services. Both vary according to the economic productivity achieved through technological development, division of labour and the volume of manufactured goods.
- * *The distribution process.* It embraces the mechanisms used inside and between societies in order to provide its members with goods (direct access, reciprocity, redistribution). Not only the distances and means of transportation, but also social and political barriers will have an effect on the value of a given product.

From the point of view of consumption, *use value* can be defined at least in the following two parameters:

- * *The material and technical utility* a product provides. This value results out of the human ability to use the properties or the quality of a product to accomplish certain tasks or to satisfy certain needs or desires. At a social, rather than individual level, the use value becomes expressed through the relative importance a product has in a specific society. Contrary to what marginalist thinking might suggest, the most useful goods in a society are the most frequent rather than the *scarce* or rare ones (e.g. water, food, dress,

housing.). The use value of the technical means does not depend on their rareness either (e.g. a power station), but on the utility of the products generated by them (e.g. electricity). Archaeology, like other social sciences, generally succumbs to a marginalist perspective when assigning on principle a much higher explicative value to rare and elaborate objects, often made out of particular materials, than to common artefacts. Implicitly a perception is projected, which assumes that the former were as *scarce* in the past as in a modern market of antiquities and therefore represented expressions of “prestige”. The explanation of the *relations* necessary in order to claim for scarcity and prestige is generally overlooked.

- * *The aesthetic and symbolic utility* a product provides. These are subjective values projected into things, which can provide either social recognition or individual redemption. Such values are either imposed through power or based on conventions inside society, and can at all moments be abolished or transformed. This makes them in fact flexible and, at the same time, indispensable for the organisation of a society at a cognitive and communicative level. From a material perspective, such values can only be approached by comparing the production value and the actual use made out of a specific object. Thus, for example, the meaning of a carefully manufactured product of a material which has circulated over a long distance, but which shows no use wear traces, must have exceeded the sphere of economic production. Frequently, such objects become *fetishes* intended to generate confusion between the actual exercise of power and its representation. Analytically this implies, that the aesthetic or symbolic contribution to value can only be recognised as an *a posteriori* result of the analysis of production and consumption processes in a specific historic context, but not as an explicative device in its own right. These two dimensions of use value (material/technical and aesthetic) would respect the distinction underlined by Graeber (2001) between objects with power to act directly on persons (and things, we would add) and objects with power to inspire actions in others.

In the particular case of the production and distribution of axes of different raw materials, these multiple dimensions of *social value* can be addressed through different analytical procedures:



- * The question of the *accessibility* to the rock deposits requires provenience studies as well as a consideration of the implications of the exploitation of different resources and environments. Crucial differences exist between primary and secondary deposits in the way rocks are exploited and social access can be restricted.
- * The *dependency* of society with respect to raw materials suitable for producing axes depends on the material and technical choices available. It is particularly important to determine the variety of rocks available in each region or territory.
- * Experimental and ethnographic data show that polishing is the most *labour intensive* part of axe production and varies according to the size of the tools. In general, it can be said that larger axes are more difficult to flake and require more time and effort to polish. Size has therefore a similar importance as the provenience of the raw material in the formation of the production value.
- * The extension, direction and barriers of *circulation* of raw materials can be reconstructed through characterisation studies of the artefacts and the geo-archaeological identification of the areas of rock extraction.
- * Functional analysis would be required in order to determine the *utility* of the axes. The observation of residues as well as traces due to use and maintenance allows distinguishing between a more utilitarian or a more symbolic charged artefacts.
- * The *quality of the raw material*, resulting from such variables as mineral composition, texture and fabric of the rocks, has a direct effect on the functional properties and hence on the use value of the artefacts.
- * The *symbolic use* of the axes can be derived from the relation observed between distance of circulation of the rock types, their resistance (or lack of it), their size and colour, and their patterns of use wear.

This analytical framework already points to several deficiencies in the current research on axe production and distribution.

- * The identification of the areas and procedures of raw material extraction has received insufficient attention, particularly in the case

of secondary clast deposits. Geo-archaeological studies, combining petrographic, geomorphological, sedimentological and paleotechnological analyses, are necessary in order to gain a better understanding of the procurement strategies and the organisation of the production of stone axes in the different regions.

- * Petrographic characterisation is frequently not combined with a morphological analysis of axes. This limits the possibilities to establish the relation between two parameters that reveal the production value of the objects, such as the size of the artefacts and the distance of circulation from the source.
- * There is a general absence of functional analyses of the cutting edges of the tools in order to determine their symbolic or utility value. For the purpose of this study it is assumed that all axes were used for felling trees and working wood, which coincides at least with the observations made on the collections analysed in southeast and northeast Iberia.
- * Finally, no study of the mechanical properties of different rocks employed as axes in the western Mediterranean has been undertaken so far. Specific tests are needed to compare these rocks in terms of their robustness (Delgado *et al.* 2009).

Consequently, the following discussion of axe production and distribution in the western Mediterranean will necessarily centre on *production value* through the criteria of the *accessibility* to raw materials, the *dependency* from particular sources, and the *extension* of the distribution network in both spatial and temporal terms. Wherever possible the *dimension* and possible *aesthetic utility* of the axes will also be taken into account as a means to approach their *use value*.

Petrographic information

One methodological difficulty when comparing the main petrographic studies carried out in the western Mediterranean (*Table 1*), concerns the use of varied terminologies and classificatory criteria, partly due to different research traditions. In the case of the Iberian Peninsula, it has been necessary to revise and organise the nearly 500 available identifications into new lithological groups. In publications that provide no

detailed description of the mineral content and the rock structure, groupings can be based only on general rock classification.² This revision of previous groupings has identified six main lithological groups in the Mediterranean regions of the Iberian Peninsula.

Iberian Group 1

Micro-gabbros or meta-basites. These are basic rocks (low silica content) which have frequently been metamorphosed. Although the degree of metamorphism, which becomes evident in the formation of secondary amphibole, can be variable, the rock retains its original igneous characteristics, at least in a residual form. Lithologically, rocks in this Group include: dolerites, meta-gabbros, epi-diorites, actinolitic hornfels and ophites. They may occur as plutonic intrusions in some coastal areas and pre-litoral mountain chains of the western Mediterranean, especially in those of Alpine formation, such as the Betic range, the Rif and the Pyrenees.

Iberian Group 2

Amphibolites. Metamorphic rocks formed mainly from amphiboles and plagioclase. They are transitional with regards to Group 1 rocks but with a higher degree of metamorphic alteration. Such rocks outcrop in the Betic Mountains and the Pyrenees, as well as in the west of the Iberian Peninsula.

Iberian Group 3

Eclogites. These are unusually dense rocks. In general terms, this group consists manly of highly metamorphosed gabbros and basalts. The mineral composition of these rocks normally contains garnet and sodic pyroxene, which can be associated to amphibole, quartz and rutile. On the Iberian Peninsula they are

restricted to the most deformed and metamorphosed parts of the domains of the Nevado-Filabride Formation of the Betic Range.

Iberian Group 4

Sillimanitic gneisses and schists. These high temperature metamorphic rocks are characterised by the presence of sillimanite needles. These rocks appear occasionally in the Alpujarride Formation of the Betic Mountains, as well as in the Central Spanish range.

Iberian Group 5

Olivine basalts. These are mainly volcanic rocks rich in plagioclase, clinopyroxenes and olivine. Their most probable sources are the volcanic formations of the Campo de Calatrava (Ciudad Real), although certain exposures around Cartagena and Mazarón in Southeast Iberia, should also be considered.

Iberian Group 6

Hornfels. These are rocks produced by contact metamorphism, and are normally rich in cordierite and/or andalusite. The eastern Pyrenees and the coastal and pre-litoral mountains of Catalonia contain abundant exposures of hornfels.

Besides these six principal lithological groups, other rocks, such as serpentinite and metamorphosed micro-conglomerate, have been used in the production of axes in Iberia, but less commonly.

Two lithological groups of stone axes and adzes occur beyond the Iberian Peninsula. The first group, calcitic amphibolite, consists mainly of hornblende, actinolite and plagioclase, and outcrop on the northern side of the Pyrenees. The second comprises the well-known eclog-

Table 1.
Importance
(expressed in %) of the
principal lithological
categories used for the
production of polished
stone axes in different
regions of the western
Mediterranean
(N = number of
petrographic
identifications).

Region	Gr. 1	Gr. 2	Gr. 3	Gr. 4	Gr. 5	Gr. 6	Other	N	Bibliography
Granada	39	29	17	5	5	0	5	41	Carrión & Gómez 1983
Almería & Murcia (coast)	67	22	3	6	1	0	1	73	Gusi & Olaria 1991; Risch 1995; Martínez & Risch 1999; García <i>et al.</i> 2005
Murcia (interior)	62	22	0	14	2	0	0	63	Barrera <i>et al.</i> 1987
Southern Levante	58	18	2	14	<1	1	6	455	Orozco 2000: 143
Cuenca	23	36	0	31	2	6	2	48	Barrera y Martínez 1980
Soria (Ambrona)	29	3	0	58	0	11	0	38	Orozco 2005
Catalunya	3	1	0	<1	0	90	6	477	Clop 2004; Risch & Martínez 2008
	CaAmphibolite		Eclogite / Jadeite						
Rosellón	36		14			31	15	207	Ricq-de Bouard 1996
East Lanquedoc	15		36			10	41	209	Ricq-de Bouard 1996
Rhone valley	3		48			<1	48	189	Ricq-de Bouard 1996
North Italy	0		80			0	20	680	D'Amico 2005: table 2
Corsica	0		10			0	90	49	Colonna 2007: table 9

ites and jadeites from sources in the western Alps and northern Apennines. Of less importance in terms of their limited distribution, is a group of glaucophane-rich rocks, which were mainly used around Durance and the Rhone valley.

In order to allow a quantitative analysis of the petrographic data the information has been organised into regional units, instead of single archaeological sites (*Table 1*). In this way, the sample size becomes larger and sample bias resulting from discard patterns, recovery processes (ranging from systematic excavation to private collections) and different petrographic sampling strategies, is reduced.

Spatial and temporal patterns

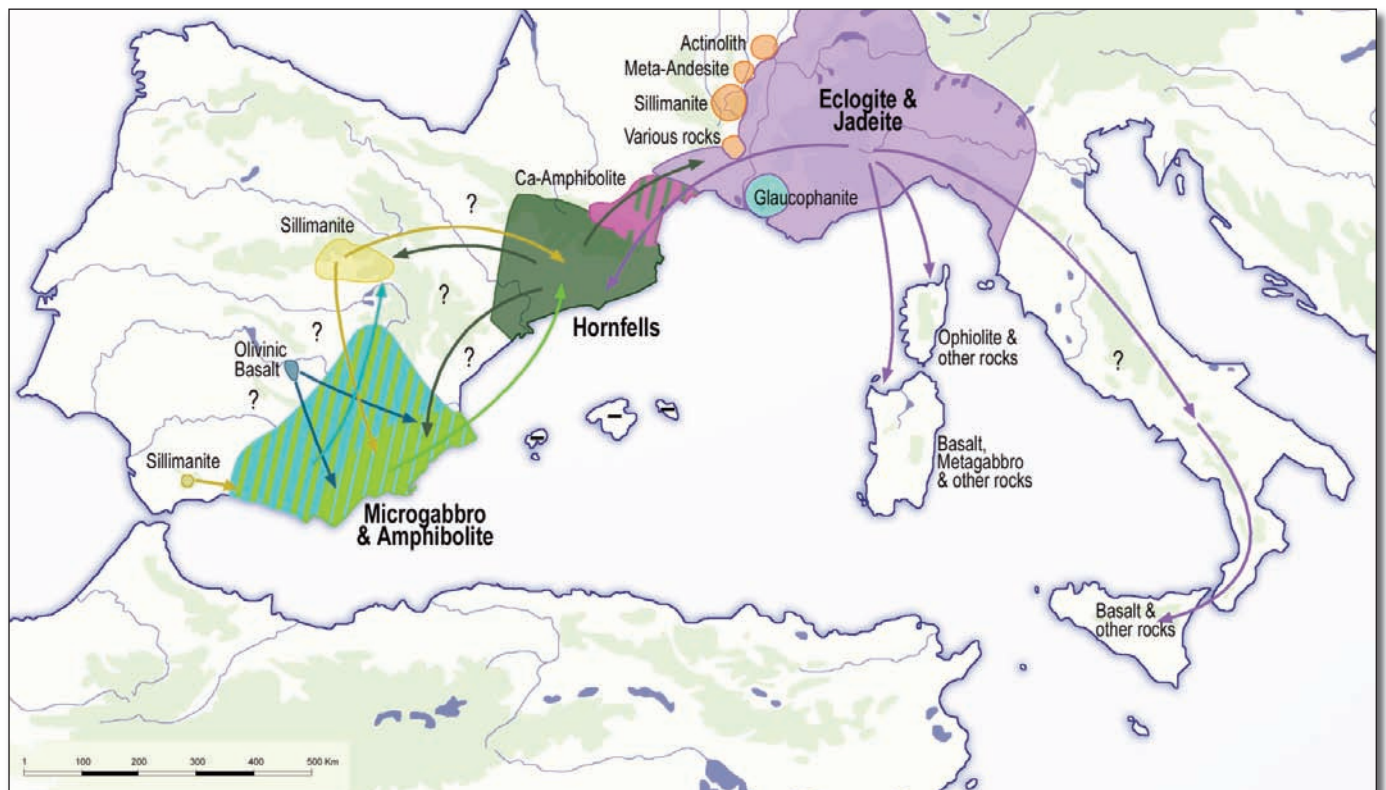
In general, the available petrographic data suggests three main geographical areas along the northern coast of the Mediterranean basin where axe production was dominated by a particular type of rock. At the margins of these areas, some rock types seem to have a more local distribution (*Fig. 1*).

The most important and extensive geographical area embraces the western part of the Alps and the adjacent regions, mainly the Po valley and Provence (*Fig. 1*). In this area, metamorphic meta-basites, such as eclogites and, more occasionally, jadeites were employed

extensively from the 6th to the 3rd millennium BCE. Such rocks crop out in the western Alps and the northern Apennines. However, they can also be found in the glacial and fluvial deposits of Liguria, Piamonte, Val d'Aosta and the upper Rhone Valley (D'Amico 2005; Thirault 2005). Moreover, in recent years, several pre-historic quarries have been discovered in the area around Monte Viso (Pétrequin *et al.* 2006). From their location between 1800 and 2450 meter O.D., and the relatively small sizes of the primary outcrops and boulders, it seems clear that the access to the outcrop of this raw material was highly restricted. Although the exploitation of clast deposits cannot be ruled out, until a detailed analysis of the work traces on the worn surfaces of the axes is carried out, the relative importance of other rock types in this region, such as amphibolites or serpentinites, suggests that society was dependent to a large extent on the rocks obtained from these high mountain quarries.

From here, eclogite and jadeite axes were distributed in all directions, although more often towards the west and the north, reaching areas as far away as Scotland and Ireland some 1600 km distant (Petrequin *et al.* 2002). Along the Mediterranean coast these axes even reached Catalunya. In this direction, their circulation follows a typical fall off pattern (*Fig. 2*). Although the main phase of production of Alpine axes took place between 5200–3500 cal

Fig. 1:
Principal supply areas
and circulation of stone
axes in the western
Mediterranean.
(? = no systematic
petrographic studies
available; - = absence
of Neolithic axes).



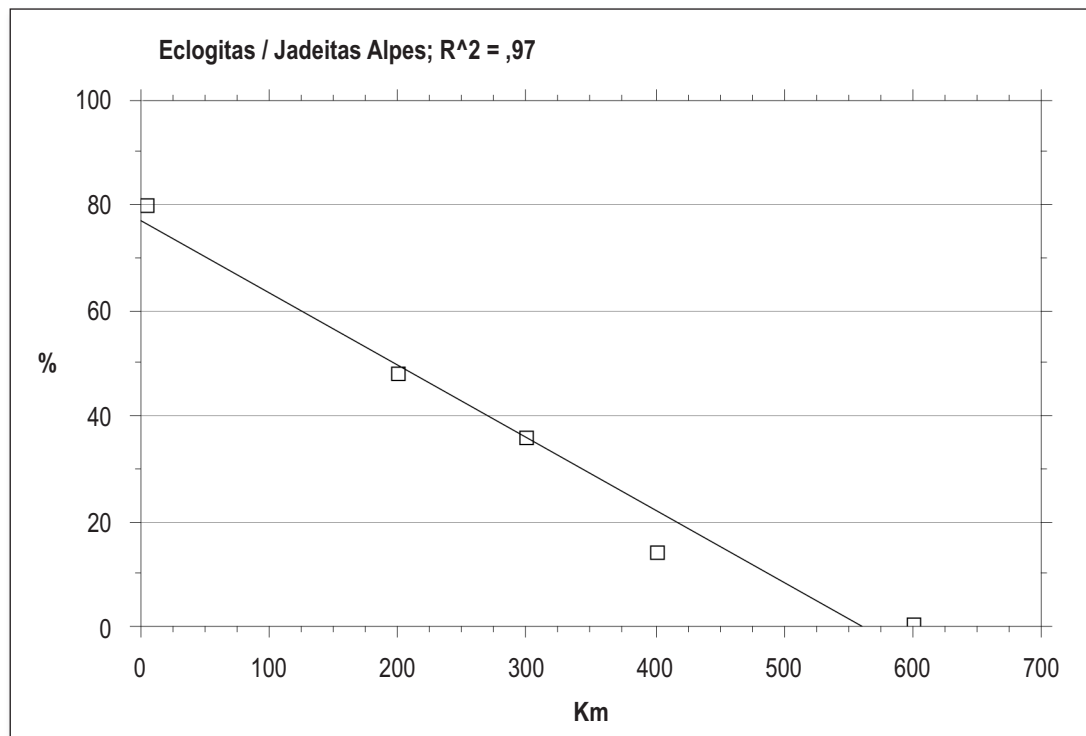


Fig. 2:

Importance of the circulation of eclogite and jadeite axes in the western Mediterranean (values according to Table 1).

The proportion (%) has been calculated in relation to the totality of axes analysed, while the distance (km) corresponds to a straight line best fit between the probable supply areas and the central geographical point of the established regions.

BCE (Petrequin *et al.* 2002, 2006; Thirault 2005), in the Mediterranean regions, such as the lower Rhone Valley and the Languedoc, they were still important until the final Neolithic or Chalcolithic (Ricq-de Bouard 1996:221).

Eclogite and jadeite are extremely resistant rocks formed by high grade metamorphism. Therefore, they are particularly well suited to the production of axes of more than 14 cm in length, and require a considerable amount of effort. The difficulty of the procurement of the raw material, the skilled preparation of the blanks, and the intensity of the polishing processes contributed to the high production value of Alpine axes; their circulation network extended throughout most of western Europe. Although such axes were well suited for felling trees or working wood, this in itself does not explain their occurrence in areas with raw materials of similar quality. Consequently, the use value of the Alpine axes may have included a high symbolic component.

Moving westwards from the Alpine production sites towards the lower Rhone valley, the use of rocks from local sources for the production of polished axes, increases (Fig. 1). These include glaucophane schist, tremolite schist and basalts (Lazard 1993; Ricq-de Bouard 1996; Ricq-de Bouard *et al.* 1998). The morphology of some artefacts as well as the location of some workshops strongly suggests that the raw materials for stone tool manufacture were obtained mainly from secondary deposits along local rivers. Their distribution was regionally

restricted in scale and they rarely represented more than 50% of the used stone axes used in any area. During the Middle Neolithic (c. 4600–3300 cal BCE), when the distribution of Alpine axes was at its height, the importance of such local resources decreased (Ricq-de Bouard 1996; Thirault 2005). Generally, these rocks were not, or could not, be made into axes greater than 14 cm in length. Their low metrical standardisation compared to axes manufactured from rock of an Alpine origin (Ricq-de Bouard 1996:151, 215) is often explained by the use of suitable clasts.

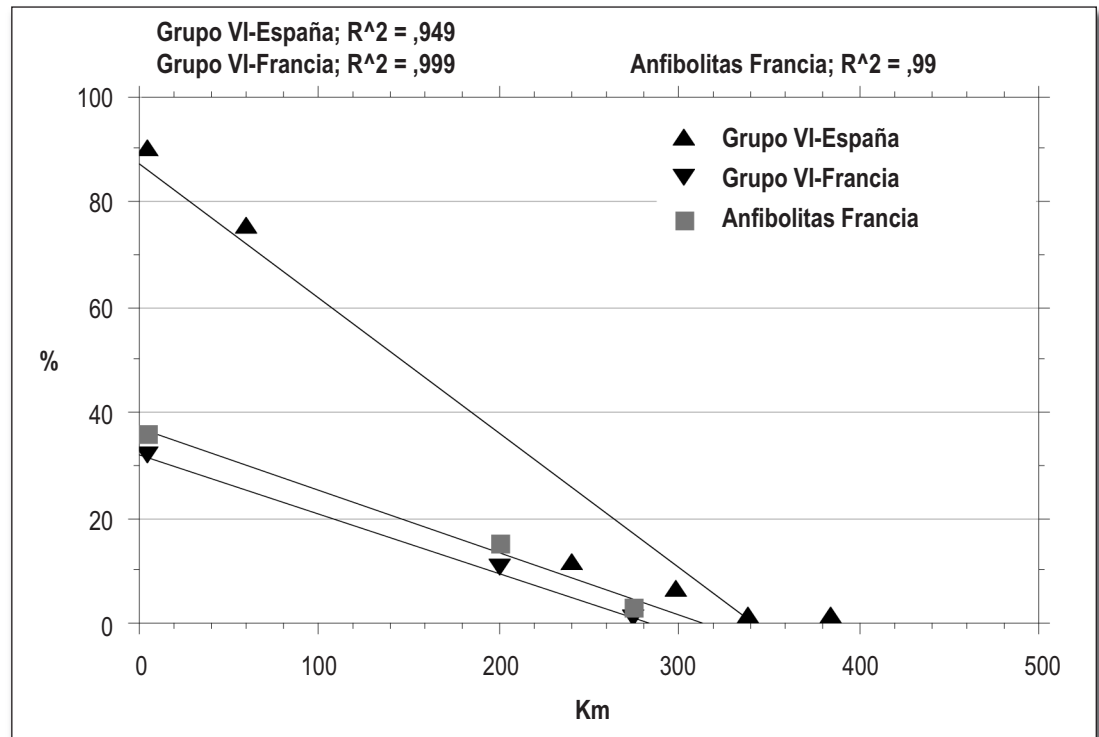
The second large geographical area is located around the Pyrenees, and is dominated by hornfels axes (Iberian Group 6). A combined petrographic and geomorphological study of the Catalan hornfels has shown that only certain secondary deposits, most of them located along the river Segre (Inner Catalonia), were exploited periodically by small communities (Risch & Martínez 2008). According to the geological and archaeological evidence, hornfels was not exploited systematically on the northern side of the Pyrenees, probably due to the lack of contact metamorphism and the lower quality of rocks suitable for tool manufacture in this area. Here, calcitic amphibolite, which provides a suitable alternative for axe production, is found in the stone tool record alongside hornfels along the lower Rhone Valley. The distribution curves of both raw materials are very similar, (Fig. 3).

Whilst the use of hornfels seems to have

Fig. 3:

Importance of the circulation of hornfels axes (Iberian Group VI) and Ca-amphibolite from the Pyrenees in southeast France and eastern Iberia.

The graphic representation follows the same criteria as Fig. 2 (values according to Table 1).



extended beyond the Pyrenees into southeastern France, a similar pattern did not occur with the amphibolite in the opposite direction. Also, the Alpine eclogite axes, which make up 22–27% of the raw materials used in the Languedoc between 4500–2200 cal BCE, rarely represent more than 1% of the axes analysed from Catalonia (Ricq-de Bouard 1996; Clop 2004). This comparative lack of axes coming from the north does not seem to be the result of qualitative differences between the raw materials. Rather, social factors may explain such spatial patterns. Somehow, the communities in the valleys south of the Pyrenees were not only in control of the secondary deposits, which included hornfels, but they also managed to limit the circulation of equivalent materials from the north. Direct access to the important rock salt deposits of Cardona in Inner Catalonia may have resulted in the exercise of stronger control within the exchange network which linked to the valleys and plains located south of the Pyrenees (Weller & Fíguls 2007). As a result, 90% of all the prehistoric stone axes in the northeast of the Iberian Peninsula were manufactured from hornfels (Clop 2004). Alternative local raw materials, such as diorite, was of only minor importance. Elsewhere, for example in the south of Catalonia, at a distance of more than 50 km from the workshops of the Segre, metamorphic conglomerates from the lower Carboniferous were utilised for tool making (Risch & Martínez 2008). However, even in the area of the Sierra

de Prades, where this material was collected from secondary deposits, these rocks only represent 25% of the polished axes.

The distribution of hornfels axes, coming from the workshops of the rivers Cinca, Ter and especially the Segre, seem to have reached its height in Iberia between c. 3750 and 2850 cal BCE, at the same time as it diminished in the Languedoc (Risch & Martínez 2008). These axes were distributed to central Spain as well as along the Spanish Levantine coast (Table 1). So far, no petrographic studies are available, for the geographical area between the rivers Ebro and Júcar in Valencia, that could provide a better explanation for the fall-off curve of the hornfels and the meta-basites coming from southeast Iberia (Fig. 1). However, at a distance of over 200 km from the source, hornfels tends to represent less than 10% of the artefacts (Fig. 3). Although hornfels clasts could be manufactured in the Catalan workshops into axes measuring over 15 cm length, the few complete artefacts found in central Spain and the southern Levante usually only measure 4.5–7 cm (Barrera & Martínez 1980:75; Orozco 2002: 200ff.; Rojo *et al.* 2005:119).

The third geographical area covers the whole of southeast Iberia (Fig. 1). In this area, more than 70% of all the axes were manufactured from metamorphosed intrusive igneous rocks (Iberian groups 1 and 2). Fine grained gabbros, dolerites, epi-diorites or amphibolites were obtained from secondary deposits. This has been shown convincingly by the study of axe

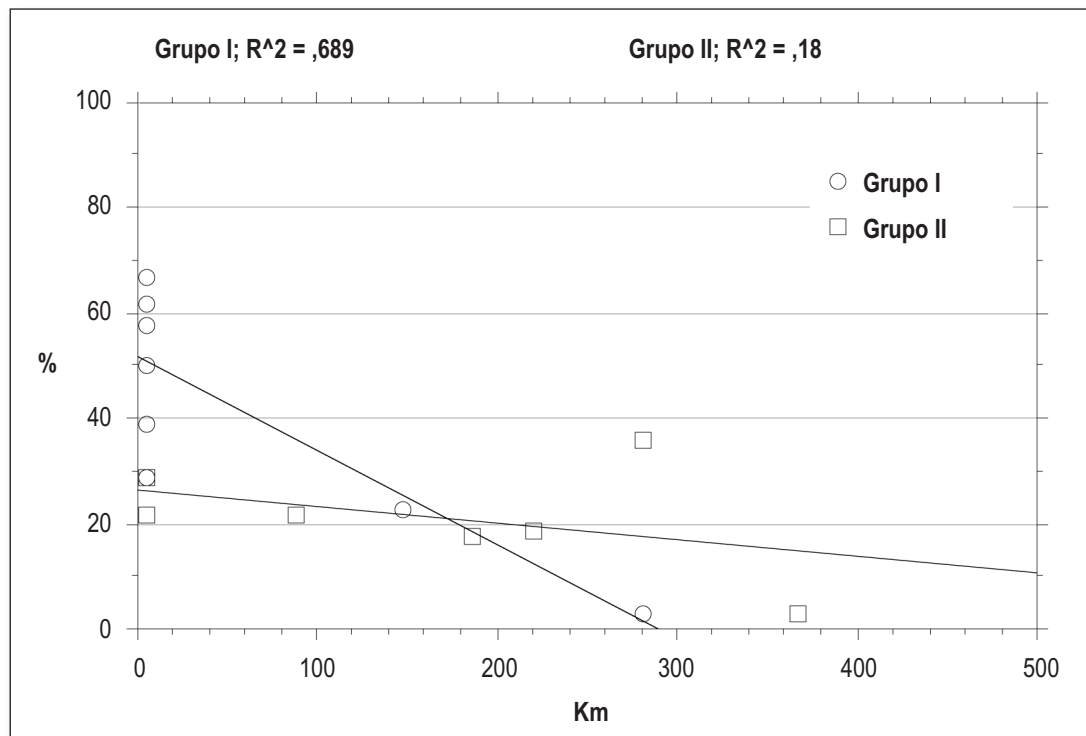


Fig. 4:
Importance of the circulation of micro-gabbro (Iberian Group I) and amphibolite axes (Iberian Group II) from the Betic area in eastern Iberia.

The graphic representation follows the same criteria as Fig. 2 (values according to Table 1).

morphology (Risch 1995:252–330). Many river deposits containing fine-grained and resistant clasts, were probably exploited for axe making; some direct evidence of axe production occurs in form of blanks or polishing slabs recorded in settlements close to the river Almanzora, Almería (Siret & Siret 1890:30; Risch 1995:343) and in Ereta del Pedregal, Valencia (Orozco 2002:115–117). In these settlements, low scale production took place in a household context, suggesting that many communities in south-east Iberia seem to have had direct access to these raw materials. So far, there is very little to suggest that large scale quarries, such as those documented in the western Alps, or specialised workshops along the rivers, as seen in Catalonia, existed in the Levante and the Southeast of Iberia.

As one approaches Sierra Nevada, the importance of eclogites increases (Iberian Group 3), which seems to correlate with the higher degree of metamorphism of this orogenic formation. West of Sierra Nevada serpentinite axes appear occasionally (e.g. Gómez in Pellicer & Acosta 1997:177f.), and a local exploitation of sillimanite schist nodules has recently be reported from the Sierra de Ronda, Malaga (Aguayo *et al.* 2007). However, all these rocks are of only minor importance, and they rarely represent more than 20% of the axes found in the different sites.

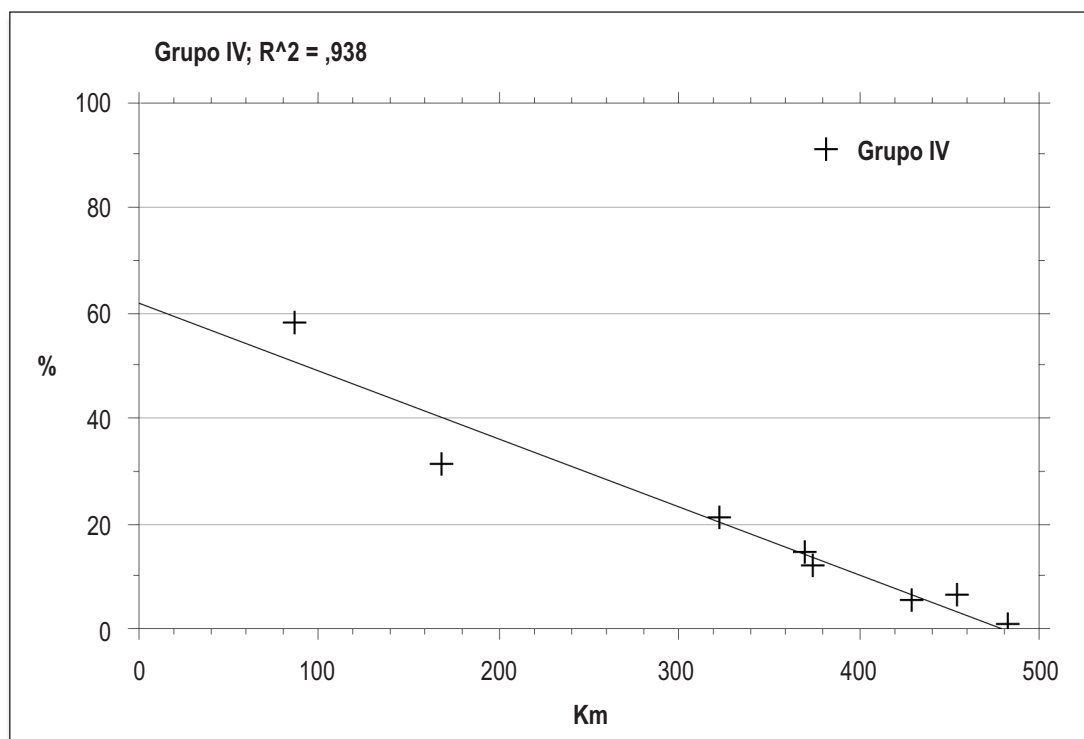
Regarding the use and distribution of micro-gabbros and amphibolites originating from the fluvial deposits of Southeastern area, it can be

observed that the former seem to have a greater importance at the local level, while the latter are more likely to be distributed over greater distances (Fig. 4). Amphibolite from sources in the Southeast was the dominant raw material used in the area of Cuenca, which is located in the eastern part of the central Spanish plateau, and where no suitable raw materials for axe making was readily available (Barrera & Martínez Navarrete 1980). Elsewhere, in the settlement of Ereta del Pedregal (Valencia) 20% of the complete axes have been identified as amphibolite, although a local manufacture of dolerite axes is also a feature of this site (Orozco 2000:115–117). Apparently, in the Southeast a twofold value system emerged in relation to the different raw materials available. Although medium to fine-grained igneous rocks were abundant and easily accessible, the less common metamorphic amphibolite was more highly valued for exchange, perhaps due to its superior technical or aesthetic value. In terms of chronology, the use and distribution of Iberian Groups 1, 2 and 3 axes started in the Neolithic, but reached its climax during the 3rd millennium cal BCE. At this time, around 70% of the material analysed from the southern Levante had come from the Southeast (Orozco 2002:181ff.).

So far, no significant dimensional differences can be observed between axes based only on the raw material used in their manufacture.. The mean length of the axes with a symmetrical cutting edge is 9.3 ± 2.6 cm in southeast Iberia,

Fig. 5:
Importance of the circulation of sillimanite probably coming from the Central Spanish range (Iberian Group IV).

The graphic representation follows the same criteria as Fig. 2 (values according to Table 1).



while the asymmetrical adzes measure about 7.0 ± 1.3 cm (Risch 1995:200f.). Although a small number of axes measure over 15 cm in length, these artefacts are not distributed differently than smaller artefacts. In general, neither the contexts of deposition, nor the raw material suggests that longer axes were valued more highly to the south of Catalonia or towards central Spain.

The overall distribution pattern for small-size sillimanite adzes is unlike those for other geographical areas or petrographic groups. Nodules of pure sillimanite (Iberian Group 4) occur in secondary deposits around Somosierra, in the central Spanish mountain ranges (Barrera & Navarrete 1980:76).³ These nodules, which occur in surface deposits, seem to have been the dominant raw material used for stone tool making in north-central Iberia, probably forming another geographical area of axe production and distribution (Delibes 1975; Orozco 2005). The fall-off curve for sillimanite in the western and southern parts of Iberia would be consistent with such an origin in central Spain (Fig. 5). Petrographic analysis confirms that axes of pure sillimanite reached at least the provinces of Alicante and Murcia, nearly 400 km away from the proposed source (Barrera *et al.* 1987; Orozco 2000). The distribution of these axes into the Levante and the Southeast was particularly important during the Copper Age, c. 3000–2200 cal BCE, but ceased abruptly early in the Bronze Age.

The sillimanite axes can be distinguished

from other materials because of their light colouring (white-yellowish to pale brown), thinness and small size. In this case, particularly small tools, rather than large ones, were valued as exchange objects. Whereas in central Spain, where axes of more than 7 cm in length were produced, the western regions, adzes with a mean length of 3.9 ± 1.1 cm. seem to predominate. No statistically significant differences have been observed between the material from Cuenca, the southern Levante and the Southeast. This could be interpreted as an indication of a simple distribution from the production areas to the distant communities (Hodder & Lane 1982).

Given this overview, it is worth considering the geological and archaeological aspects of the western Mediterranean islands. The societies of the major islands – Sicily, Sardinia & Corsica – manufactured axes from basalt, gabbro, amphibolite, serpentinite, schist and other local igneous and metamorphic rocks (Leighton 1989; Lugliè 2000; Costa 2007; Colonna 2007). A recent petrographic study carried out on Corsica reveals that at least 18 different local rock types were made into axes on the island (Colonna 2007:249). This again illustrates the gathering of river clasts rather than the quarrying of rock from primary outcrops. However, all these islands also received some artefacts made from Alpine rocks. On Corsica, imported material represented around 10% of the axes (*idem*). The smaller islands of the Tyrranean Sea were either supplied from the mainland and

the larger islands, or used local material (Leighton 1989:142).

The situation on the Balearic Islands is quite different. The Balearics are formed mainly of sedimentary rocks. Even the Palaeozoic schists and basalts of the northern coast of Mallorca and Menorca are intensely altered and do not display suitable working properties for axe manufacture (Gómez-Gras 1993; Fornós 1998). So far, only two prehistoric stone axes have been recorded, both coming from Mallorca. The first is a small adze of unknown provenience and raw material; it is kept in the Museum of Lluç, Mallorca (Vený 1968:367). The other is an unpublished hornfels axe stored in the Archaeological Museum of Catalunya.⁴ The hornfels must have reached the island from the Catalan coast, which implies a sea voyage of at least 180 km. This “negative evidence” of axe production and use on the Balearic has particular significance for our understanding of the organisation of the prehistoric stone axe distribution (see below).

Comparing axe distribution patterns

If we compare the different production and distribution patterns of the western Mediterranean, leaving aside for the moment their temporal dimension, a series of general trends seem to be valid for the majority of regions and lithologies:

1. Most of the raw materials used for axe production in the Western Mediterranean were obtained from secondary deposits. Small temporary workshops on river terraces and along the riverbeds, rather than large scale extraction sites, seem to have been the most usual places where axe blanks were flaked. The few polishing sites documented so far suggest that this activity was carried out at a low production scale in the domestic context.
2. A very different form of organisation was associated with the extraction of jadeite and eclogite around Monte Viso in the Piedmont. Although clasts of the same materials occur in fluvial deposits, the stone quarries discovered in the Alpine mountains suggest a specialised production of axe blanks between 5200–4000 cal BCE (Petrequin *et al.* 2006). In the context of the western Mediterranean, where the exploitation of river deposits was the main procurement

strategy, high mountain quarrying must have been perceived as an exceptional activity of a special social and political character.

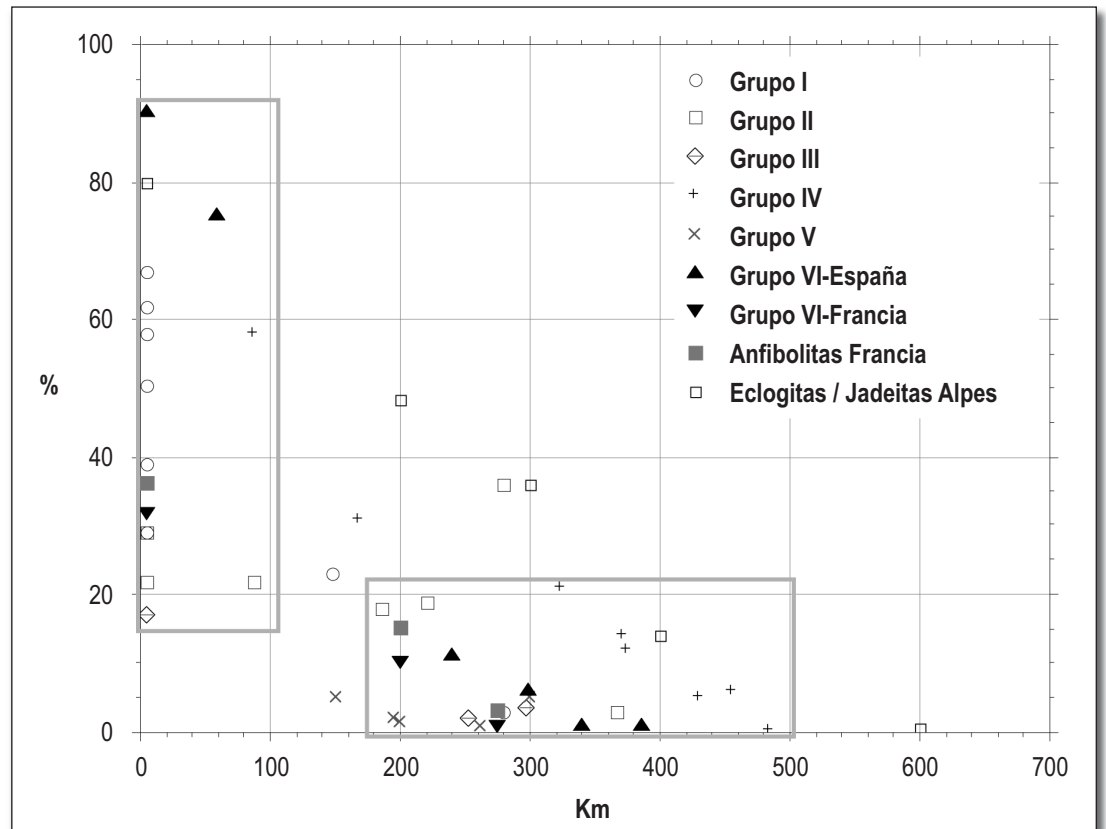
3. Apart from the Alpine rocks, hornfels and a variety of gabbros/amphibolites were the principal raw materials used in the production of adzes and axes. They were used extensively across an area of c. 100 km around the areas of extraction or the production workshops. Factors such as the accessibility and variability of rock types in the local Quaternary deposits, their different working properties, and social preferences explain some of the differences in the ways in which different rock types were exploited. This system of dispersal would have ensured access to a highly sophisticated distribution of labour and technology between the 6th and the 3rd millennia BCE.
4. In the case of the Alpine rocks, the main geographical area of supply (where alpine stone accounts for more than 50% of axes) extends up to a radius of 200 km (Fig. 2; also Thirault 2005). Moreover, this raw material circulated over greater distances than any other rock type, reaching Catalonia in the West or Sicily in the South.
5. At the fringes of these three main ‘supply territories’, organised respectively around the Alpine eclogite/jadeite, the hornfels from the Pyrenees and the Betic micro-gabbros/amphibolites, one notes the search for local resources (Fig. 1). The use of material from local secondary sources was restricted to local or regional needs, apparently due to the lower quality of stone tools manufactured from these rocks.
6. About 200 km from its source – 300 km in the case of the Alpine materials – a rock type rarely represents more than 20% of the circulating axes (Fig. 6). Only in areas lacking an adequate supply of suitable raw materials, such as the south-eastern part of the Spanish Meseta or the eastern Languedoc, do particular rock types occupy a dominant position among the used raw materials. On the one hand, this suggests, that diversity of raw materials and, hence, of proveniences, was favoured above specialization on, and dependency for, one particular source and circulation network. On the other hand, this pattern points to a general difficulty to guarantee a regular supply of rocks and axes over large distances. Formulated differently,



Fig. 6:

Importance of the circulation axes of different rock types on the northern side of the western Mediterranean. The proportions (%) are calculated in relation to the total numbers of identifications available for each region (Table 1).

The graphic representation follows the same criteria as used in Fig. 2.



this could mean that long-distance distribution further than 200 km, or 300 km in the case of Alpine materials was in most cases, not an economic necessity but rather a social or political event.

7. From a chronological perspective, it can be concluded that the territorial supply strategy based on the exploitation of secondary clast deposits seems to have been followed throughout the Neolithic and Chalcolithic. However, the distribution networks of the different western Mediterranean rock types went through cycles of expansion and contraction. Starting in the northeast, the known eclogite/jadeite quarries are dated to the first half of the 5th millennium cal BCE, while the maximum circulation of these axes occurred between 4500–3500 cal BCE (Pétrequin *et al.* 2002, 2006). The exchange of Catalan hornfels axes reached its peak in Iberia at a slightly later date (c. 3750–2850 cal BCE). Finally, the most important exchange network between c. 3000–2200 cal BCE developed in central and southeast Iberia, when axes of micro-gabbro, amphibolite, sillimanite and olivine basalt were widely distributed. This gradual displacement of the long distance axe exchange networks from the Alps towards the Betic Mountains seems to coincide in

each region with periods of economic intensification and social dynamism, such as the Atlantic Megalithism, which attracted considerable quantities of Alpine material; the Catalan Fosa Culture, in the case of the hornfels axes; and the Los Millares phenomenon in southeast Iberia in relation to micro-gabbro and amphibolite tools. The observed patterns can thus indicate very different causes; they need to be interpreted and explained in their respective regional and temporal contexts, as discussed below.

Further implications

The general conclusions derived from the analysis of the axe and adze distributions between northern Italy and southern Spain have important implications for one of the unresolved archaeological questions in this area, which concerns the surprisingly late colonisation of the Balearic Islands in comparison to other Mediterranean islands (e.g. Vigne 2000:Fig. 2). Although the possibility of “accidental visits” in earlier times cannot be ruled out (Lull *et al.* 1999:20), the available information suggests that the first stable occupation of the four major Islands occurred during the second half of the third millennium (Ramis & Alcover 2001; Lull *et al.* 2004; Micó 2005). The

central geographical position of Mallorca and Menorca in the western Mediterranean and, hence, their relative remoteness from the mainland, definitely limited accessibility to the islands (Cherry 1984). However, geographical factors alone cannot explain such social isolation (Lull *et al.* 2002), especially if one takes into account that Ibiza is visible from Alicante, and that, under optimal conditions, Mallorca can be seen from the coastal mountain chain of Catalonia. Moreover, the Balearic Islands would have had a high agricultural potential, given the necessary means for clearing the land from its middle Holocene vegetation cover.

In the Neolithic, the absence on the islands of fine grained and resistant raw materials, necessary for the production of stone axes, would have been a much more critical problem for permanent occupants, than the straight-line distance from the mainland alone. Difficulties in providing a massive supply of stone axes further away than 200–300 km would have dissuaded early colonization by agricultural communities, which depended on these tools in order to clear the Mediterranean evergreen oak forests and the dense maquia dominated by wild olive and mastic (Piqué & Noguera 2002; Pérez-Obiol & Sadori 2006). Fire alone is not sufficient to remove this type of hard wood. The rarity of stone axes on the Balearic Islands confirms that permanent settlement, especially of Mallorca and Menorca, could only develop when either exchange networks were sufficiently in place to provide a regular supply of tools, or when axes could be manufactured from other materials, e.g. metal.

Both conditions seem to have been fulfilled in the western Mediterranean for the first time during the 3rd millennium BCE. The earliest evidence of metallurgy close to the Balearic islands occurred in the region of Cabrières (Languedoc), where an important copper production centre developed between c. 3200–2400 cal BCE (Ambert *et al.* 1998, 2005). It might be no coincidence that the end of the metallurgical activities around Cabriers coincided approximately with the beginning of permanent occupation on Mallorca, taking into account that several archaeological elements point to the Languedoc and northern Catalonia as the probable origin of the first settlers (Lull *et al.* 2004; Micó 2005). It is also clear that these communities were engaged in copper production, as confirmed by the discovery of crucibles with Beaker-style decoration in a rock shelter at Son Matge on Mallorca (Waldren 1979), and apparently mined small copper ore deposits along the northern coast (Ramis *et al.* 2005; Alcover

2008). For the first time, the smelting of these ores could have allowed local (metal) axe production which did not depend on the supply of raw materials shipped from the mainland. A further advantage of the use of metal in comparison to stone in a situation of limited supply, is the possibility of the recycling of the former through melting and forging, irrespective of the provenience of the original raw material.

On the other hand, it is generally accepted that the second half of the 3rd millennium and, specially, the Bell Beaker period, was a phase of intense movement of social groups, materials and information in western Europe. Rather than unknown islands, because of their biogeographical conditions, the Balearic archipelago could have been seen during the Neolithic as remote and inhospitable islands. The moment the technical possibilities and the social organization led to an intensification of production and to a widening of the exchange networks, their colonization was no longer delayed. It was favoured moreover by a situation of social conflict and violence which occurred across the continent (Lull *et al.* 2004).

Discussion

Patterns of axe production and distribution in the Western Mediterranean regions raise questions about the value of the exchanged products, that is, about their significance in the social contexts in which they circulated. With the exception of Alpine jadeite production during the fifth millennium, *the dominant form of stone axe production in prehistoric western Mediterranean did not involve a marked technical specialization, nor a centralised social control.* The *production value* of axes, defined in terms of the *accessibility* to raw materials, the *dependency* from particular sources and the *extension* of the distribution network, was limited by means of a particular economic organisation. Crucial to this organisation was the exploitation of clasts from local fluvial deposits and the limited importance of the circulation of these axes beyond c. 200 km from their sources. This strategy considerably limited the efforts required both by the production and distribution process, and the possibilities to restrict access to the raw materials. Moreover, communities seem to have avoided dependency on single raw material sources when these occurred at distances outside the local area, in order to have a reliable supply of stone tools. This led to the notable diversification of the rock types and provenances for axes from regions located more



than 200 km away from the raw material sources. It is precisely this difficulty to organise, in economic as well as social terms, regular supply networks over larger distances, which explains the exceptionally late colonisation of the Balearic islands, which have excellent soils and climatic conditions but lack suitable rocks for a local axe production.

It is possible to infer several different forms of political relation based on this economic organisation. What is clear is that the potential to impose relations of social exploitation through the control of polished artefacts must have remained limited throughout the western Mediterranean. On the one hand, it is questionable whether or not the *production value*, understood in the sense of the *efforts and means* implied in manufacture, accompanied the axes in their circulation beyond a certain point in space and time. Communities were probably not aware of the specificities of the production processes of the few axes that arrived from distant sources. On the other hand, all rock types chosen in the western Mediterranean seem to have made reliable tools. Although the mechanical properties of the rocks still need to be tested, signs of intense use suggest that all tools had a similar *use value*, understood in the sense of the *material or technical utility* of the products. Consequently, if the axes circulating beyond 200–300 km had any particular social value, it could only emerge out of their *limited accessibility* and a higher *aesthetic utility*. The observation that the rocks with the most distinctive colours and textures, i.e. jadeite/eclogite and sillimanite, were also travelling over the largest distances supports such a symbolic meaning of axe exchange. These networks seem to have been influenced by categories such as rareness and formal distinctiveness of the products, rather than dependency and improved productivity. We might rather understand such objects as *fetishes* masking political control over inter-communal exchange and communication. This would explain why unequal access to “wealth” becomes expressed in Neolithic and Chalcolithic funerary contexts principally by objects or raw materials of distant origin.

However, the observed tendency to rely for the most part on easily accessible local resources, and to receive axes from different distant sources, must have undermined the expansion of these forms of power towards more exploitative structures within the communities. The accumulation of axes shown by the distribution patterns confirms that the powerful positions derived from the control of these exchange products was uneven in space and

limited in time (see also Pétrequin *et al.* 2002). In this sense, it can be argued that the particular situation of the Bretagne in the fifth millennium, with its exceptional capacity to attract Alpine axes (Klassen *et al.*, in press), was caused by the attempt to narrow the variability and meaning of *fetishes*, thereby increasing the dependency on one particular exchange object, route and accompanying information.

In the fourth millennium, when the Catalan hornfels network was at its height, two separate regions are distinguished by an uneven accumulation of wealth in some single burials characterising the *Fosa Grave culture*. These were the Vallès region around Barcelona, which had direct access to the variscite deposits of Gavà as well as to marine resources, both used for the manufacture of ornaments (Bosch & Estrada 1994) and the Solsonès region in the inner part of Catalonia, where communities obtained excellent hornfels clasts from the middle Segre river (Risch & Fernández 2008), as well as salt from Cardona (Weller & Figols 2007). Artefacts manufactured in both regions were involved in long-distance distribution networks, and were placed in graves often associated with other exchange goods, such as obsidian from Sardinia, jadeite from the Alps or “silex blonde” thought to come from southern France. *This clear link between wealth and exchange values expressed mainly in male burials supports the idea that economic and probably also political power emerged during the Neolithic and in certain regions from the control of exchange relations between more or less distant regions, and not from the appropriation of the means of production inside the communities.* While exchange values could be manipulated up to a certain extent in order to achieve certain privileges, and some communities accepted such manipulation and privileges on behalf of diverse social or ideological networks (e.g. collectiveness, solidarity, transcendence), a *direct* economic exploitation would still have been difficult to impose materially and conceptually on small scale communities with access to alternative resources and supply strategies.

However, *one should be cautious not to interpret all concentrations of elaborate artefacts of distant origin as signs of incipient political power.* A very different situation seems to have emerged during the third millennium in Southeast Iberia. The metabasites and amphibolites of this area started to dominate the exchange systems in the eastern part of the Iberian Peninsula while the long distance exchange of Catalan hornfels declined. At the same time, the Southeast and the Spanish Levante attracted

other rocks, such as sillimanite from central Spain and olivine basalt from the Southern Meseta (Fig. 1). All these axes and adzes were part of an economic system which produced and circulated an exceptionally large variety of objects of stone, bone, pottery, metal and probably also of wood and cloth throughout southern Iberia, particularly in the area of the so called Los Millares archaeological complex (3000–2200 cal BCE) (e.g. Ramos Millan 1998; Risch 1995:136–157; Orozco *et al.* 2001).

The production of these valued objects relied on part-time specialisation among communities and between regions, as well as on a diversified and highly productive subsistence production (for a general discussion of this model, see Risch 1995:528–541). Some of these objects had an *instrumental value* as labour means, but in many cases their *use value* is defined in purely aesthetic and symbolic terms. Their spatial distribution suggests that access to this form of material wealth was not politically restricted, but depended most of all on the size of the community. The appearance of these symbolically laden objects in all types of environmental and archaeological contexts does not support the notion of a centralised control exercised on production, circulation or consumption.

The constant supply of the social networks with a growing variety of elaborate objects may have resulted in the first place in a situation defined today as *inflationist* with regards to a specific type of social values. The second effect is that these values become *incommensurable*. In view of the diversity of raw materials, manufacturing techniques, textures and shapes, it becomes impossible to find common ground for comparing and judging the different objects. Finally, the existence of innumerable small-scale production centres in a wide-ranging and territorially unrestricted distribution network emphasises the *de-personalised character* of the products being circulated. *The sharing of collective values in the form of fetishes prevails over the identity of particular persons, groups or regions.*

In this situation, the distribution of polished axes over great distances does not seem to have been controlled by the supply of adequate raw materials, available in many parts of Iberia. Nor did it foster politically dominant positions through the control of exchange goods. Rather, *the creation and circulation of wealth through exceptional objects with a high production value, but of limited or replaceable economic importance appears as a mechanism to prevent the concentration of economic and political power.* The symbolic emphasis of this form of wealth production

seems to require the transmission of common concepts and values over wider regions. Such a strategy might have been particularly important at a time when southern Iberia experienced an exceptional demographic growth and economic development. *In a world of strong expansion of the forces of production and growing division of labour, the production and circulation of exotic and elaborate objects can be conceived as a form of creating wealth with strong social links, which at the same time inhibits surplus production, i.e. the appropriation of the productive forces by a few.*

The 3rd millennium in southeast Iberia provides an archaeological example where division of labour was not aimed at increased productivity, as most modern economic thinking since Adam Smith (1776) assumes. Rather, it became a mechanism to foster social communication and integration into a common value system, as Emil Durkheim (1893) has argued. In summary, this work suggests that polished artefacts participated in and generated different social relations, each being *complex* in its own distinct way. Apart from their dominant functional value for the working of wood, axes could be used as symbols of emerging political differentiation inside societies based on the control of exchange networks, or as fetishes shared among communities over wide areas. But common in all communities was the need to avoid as far as possible a dependency on single resources; to simplify access to raw materials through the exploitation of secondary clast deposits; and to limit the transportation of bulk materials. Only in the second half of the 3rd millennium, do we see major departures from this pattern; the truncation of systems of communal wealth and symbolism and the assertion by groups in some areas, of direct control over production inside their own communities. The substitution of stone by metal artefacts was probably of crucial importance in this decisive historical break.



Notes

- 1 The following standpoints of the founders of modern economic theory expresses very clearly this split between the material world and the proposed notion of value: *"In a society which disposes of all types of goods always above their needs, there would be no economic goods nor wealth"* (Menger 1871/1985:97ff); *"Useful things which are not scarce do not form part of the social wealth"* (Walras 1874/1952:21ff).
- 2 This revision has counted with the inestimable help of Francisco Martínez Fernández from the Department of Geology of the Universitat Autònoma de Barcelona. For a first discussion of this problematic see Risch (1995:136–141).
- 3 The above mentioned sillimanite schist of the Sierra de Ronda can be distinguished from this material by the presence of garnet, biotite and iron oxide (Aguayo *et al.* 2007). So far, this composition has only been documented among axes found in the provinces of Malaga and western Granada (Carrión & Gómez 1983; Gómez in Pellicer & Acosta 1997:178).
- 4 According to the documentation available at the museum this axe comes from Ca S'Hereu (Llucmajor, Mallorca). At this place a Bronze Age rock cut tomb is known, but it is uncertain if the axe was found in this tomb or comes from a different site. We wish to thank Nuria Rafel and Carmen Rovira for the possibility to analyse this artefact.

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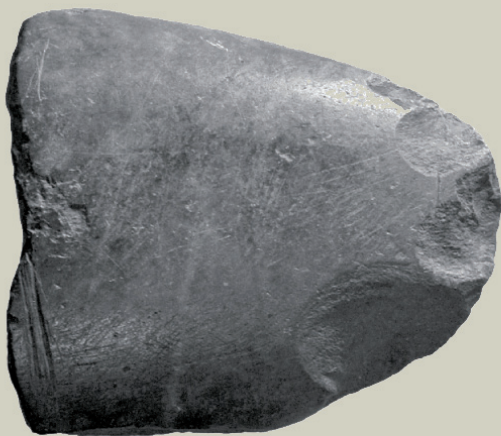
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■ ■ ■ At Gypsy Lane in Bedfordshire, fieldwork in 2003 identified Later Bronze and Iron Age occupation on the side of a shallow river valley: pits, ditches and waterholes and the post hole *footprint* of several buildings. In one of these, *Structure 12*, the post hole at the back of the building contained a curious inclusion:

“BRQ03 F.850 [3479] *Fragment from the butt end of a ground/polished stone axe/adze blade. Macroscopic characterisation suggests that the raw material is an epidotised tuff with an origin in the central Fells of Cumbria (Group VI). The butt is rounded and tapered and there are no signs of side faceting. The piece is relatively weathered and worn, with flake/fracture scars along a number of edges including the butt, which has several flake scars cutting through the ground/polished surface. The original blade appears to have suffered a lateral ‘endshock’ break, and the resulting exposed surface bears one flake scar created after the original blade was broken. Several thin grooves run along a section of the break, possibly related to hafting. Yet the lines are sharp and clean, perhaps scored deliberately to mark the axe, or as a consequence later use in the sharpening of other implements. Max. length 50 mm; max. width 46 mm; weight 88 gms.”*

The archive description is simple and direct. What it does not say is how and why a broken Neolithic blade became part of the fabric of a building as much as three thousand years after it was first flaked and ground into shape. Occam’s razor may cut to the view that inclusion was simply the satisfaction of an immediate need for packing, a reaching out for stone that was ready to hand. But this is not an isolated case. Similar associations occur elsewhere in Britain and in Scandinavia, where axes even turn up as placed deposits in Iron Age graves. We shouldn’t be surprised by this. Iron Age communities in many regions often made sense of the world around them through references to *ancient monuments*; old burial mounds and other sites that connected them to mythic pasts. Old axes were also caught up in this process, featured in stories of origins, spirits and gods. These were stones that sparked and smoked when struck, thunderbolts hurled to earth by powerful forces. Even then, an offering made the lightning strike elsewhere. ■

●●● *If you look closely at the publication photo, you'll see the thin line of a flake scar on the cutting edge. The axe was being taken round to the studio to be photographed and S had it balanced on top of a book. So it slid off and hit the floor, knocking out a deep flake. He was mortified, but I found the flake and stuck it back on. You can hardly tell, but all I ever see now is the break. ●*



The felsite quarries of North Roe, Shetland

– An overview

Abstract

The present paper sums up the information gained during the author's surveys of the North Roe peninsula, northern mainland Shetland. The purpose of these surveys was to inspect the area's numerous felsite dykes, as mapped by geologists Phemister, Harvey, & Sabine (1952), to find out whether these had been exploited in prehistory.

In general, most of the more substantial felsite dykes had been quarried, or at least prospected, probably mainly during the Neolithic period, and probably largely to procure raw material for the manufacture of polished Shetland knives and axeheads. Some of the most heavily exploited outcrops were associated with shelters, and a small number of cairns, as well as a possible Neolithic house, are also known from the area. In this paper, results from the first survey (presented in Ballin forthcoming b) are supplemented by the achievements of later surveys, during which the most remote dykes were investigated.

The paper is concluded by a discussion of the North Roe felsite quarries in their Neolithic setting and a presentation of a research strategy for the near future.

Introduction

The felsite quarries of North Roe, Shetland, were briefly touched upon in Ritchie's (1968) paper on *The Stone Implement Trade in Third-Millennium Scotland*, in which he also discussed the sources and distribution of Rhum bloodstone, Arran pitchstone, Irish porcellanite, and Perthshire hornfels. Despite the facts that 1) Shetland felsite is one of the most spectacular toolstones in Britain, and 2) the North Roe felsite quarry complex is one of Britain's largest (probably only superseded by the Great Langdale 'axe factories' in Cumbria; Bradley & Edmonds 1993), this resource has never been exposed to more detailed scrutiny.

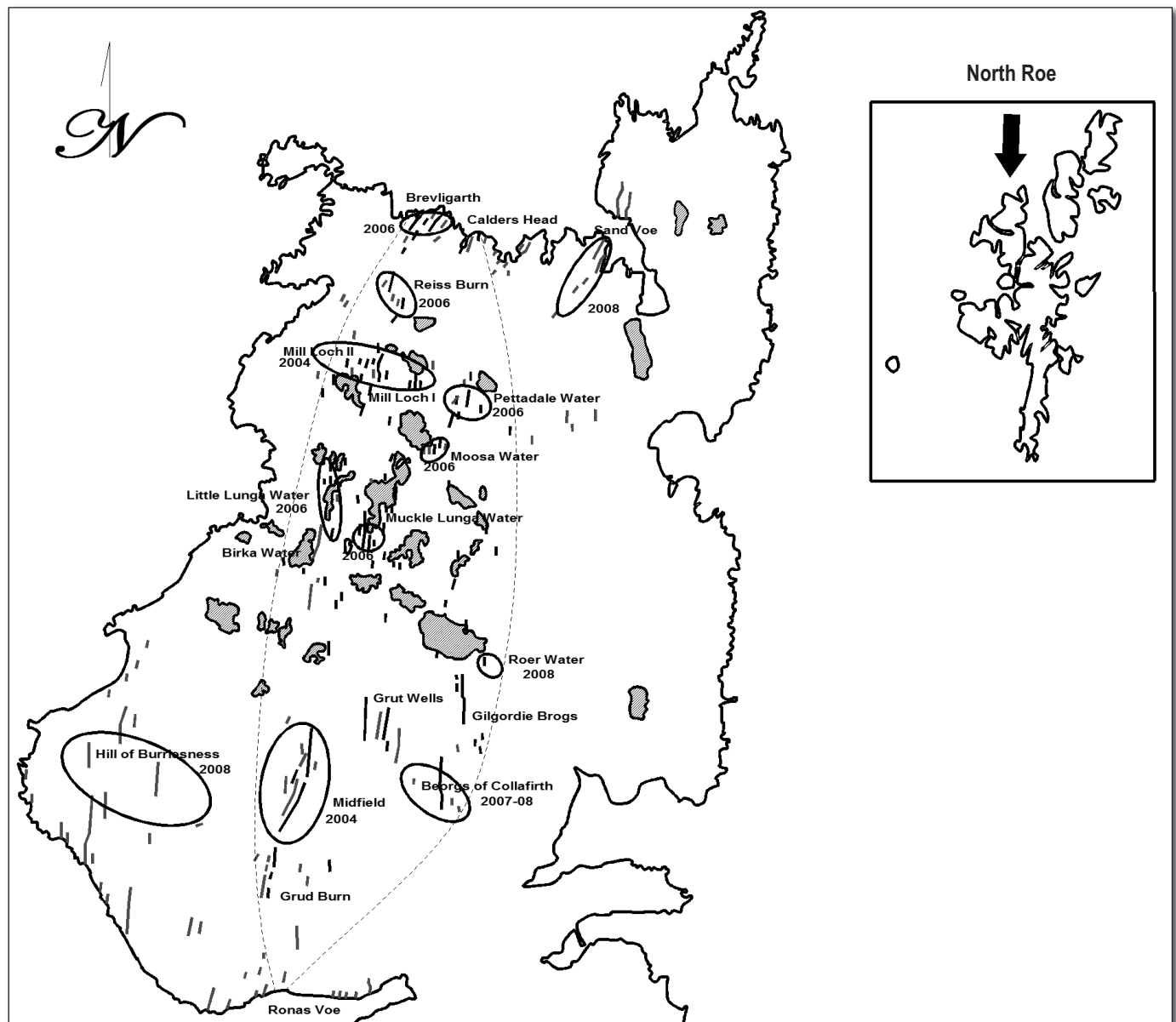
As a response to this *state of the art*, the author set up the present project (*The North Roe Felsite Quarry Complex*), the main aims of which

were to survey the affected area and prepare future and more detailed investigations of the quarry complex. In a preliminary paper from this project (Ballin forthcoming), the raw material felsite was defined, divided into distinct sub-types, and discussed, and the outcrops and features of the most heavily exploited parts of North Roe (the Beorgs of Uyea, or Mill Loch I/II, and Midfield) were presented (Fig. 1). This paper was based on the survey of 2004.

Since then, further surveys have been carried out, guided by Phemister *et al.*'s (1952) overview of geological outcrops of felsite in North Roe, and focusing on the parts of North Roe which were not covered by the 2004 survey. In 2006, the low-lying areas in the centre of the peninsula were dealt with, as well as a ridge south of Pettadale Water (an extension of the Beorgs of Uyea); in 2007, a survey of the Beorgs

Fig. 1.
North Roe.
Dykes and main concentrations of dykes:
black, riebeckite-bearing felsite dykes;
grey, other felsite dykes
(after Phemister *et al.* 1952).

The smaller map indicates the location of North Roe within the Shetland Isles.



of Collafirth was initiated, but not completed; and in 2008, the survey of the Beorgs of Collafirth was completed. This work was followed by investigations of the central parts of Burriesness, the eastern end of Roer Water, and the southern SandVoe dykes.

The aims of the present paper are:

- 1) to present an overview of the knowledge of the North Roe felsite quarry complex obtained over the period 2004–08;
- 2) to discuss the felsite quarries in their Neolithic setting; and
- 3) to propose a strategy for future research into the quarry complex.

The raw material

As explained elsewhere (Ballin 2004), the term felsite, as it is commonly used by archaeologists, refers to a number of related rock forms, which were used as toolstones (*Table 1*).

Table 1.
Felsite sub-types
encountered in North Roe
(adapted from
Phemister *et al.* 1952; also
Ballin forthcoming b).

- | |
|--|
| 1 Riebeckite-bearing felsites |
| 1.1 Non-porphyritic, non-spherulitic felsites |
| 1.2 Non-porphyritic, spherulitic felsites |
| 1.3 Porphyritic, spherulitic felsites |
| 2 Felsites without riebeckite or aegirine |
| 3 Quartz-feldspar porphyries |

Ritchie (1968) singled out riebeckite felsite, due to its spectacular appearance, but prehistoric people appear to have exploited all the forms of felsite listed in *Table 1*. Examination of the felsite implements held by Shetland Museum showed that, apparently, different forms of felsite were preferred for different implement types. The axeheads are generally in relatively plain, homogeneous forms of felsite, without spherulites, but frequently with small phenocrysts of quartz and feldspar, and their colours mainly vary between purple and dove-grey. The knives, on the other hand, are much more spectacular, with blue, blue-green, or purple colours dominating, and with above-average size spherulites, but mostly containing few phenocrysts.

Exploited outcrops

Although it has only been possible to survey selected areas of North Roe (and within these areas, only selected outcrops), it is now possible to indicate where felsite was exploited most

extensively and where prehistoric activities appear to have been more ‘patchy’:

- * The most intense quarrying operations clearly took place at the Beorgs of Uyea (including Mill Loch I/II, and Pettadale Water) in the north and on the slopes of Midfield in the south;
- * in prehistory, extensive dykes were prospected at Muckle Lunga Water in the peninsula’s central parts, and on the northern slope of the Beorgs of Collafirth;
- * throughout North Roe, small concentrations of waste have been found, ‘peering’ through the peat cover; whereas
- * no signs of exploitation were noticed at Sand Voe (north-east), Brevligarth (north-west), and in Burriesness (south-west).

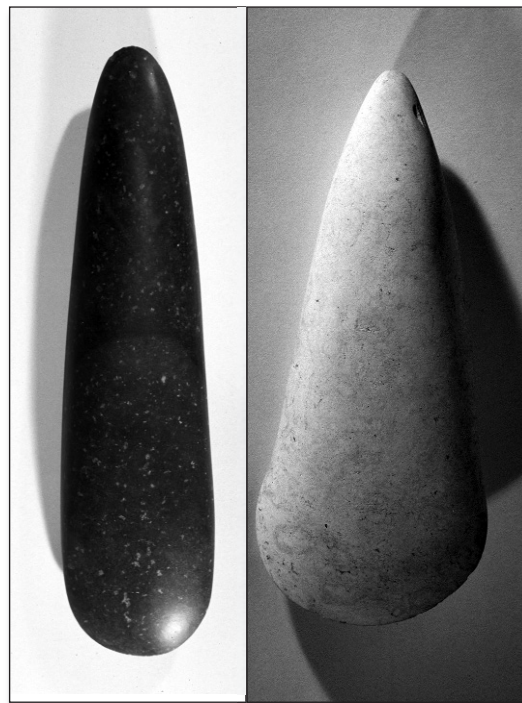
A number of locations remain to be surveyed – such as Gilgordie Brogs, Grut Wells, and Grud Burns – and Burriesness is such a vast area that further investigation is necessary (*Fig. 1*). However, the most likely distorting factor is probably the Shetland blanket peat, which in some areas is metres thick. As mentioned, there are locations where the peat has been worn off (either by sheep, wind, or water), and where felsite waste can be seen through the ‘scars’. In these cases, it is impossible to say whether the remains represent extensive or spatially/temporally limited quarrying activities, workshops or complete domestic sites. As most of the felsite procurement activities are thought to have taken place during the Neolithic period, and as the blanket peat is largely a later phenomenon, important pieces of the puzzle (such as possible domestic sites in the peninsula’s lower-lying areas) are now invisible.

Artefact types

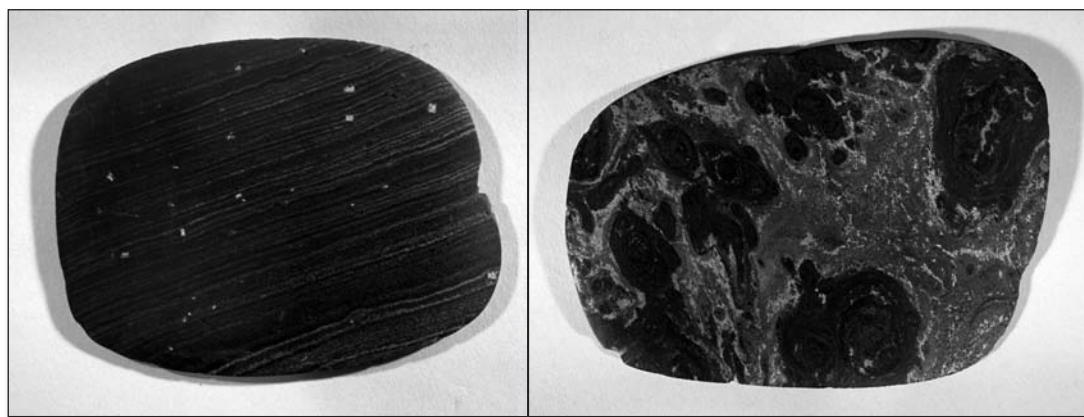
The author’s examination of felsite implements held by Shetland Museum (and found throughout the island group) clearly showed that the quarrying of felsite in North Roe focused on procuring raw material for the production of mainly axeheads and Shetland knives (Shetland knives are large polished oval knives of felsite, morphologically resembling certain discoidal knives in flint; see below) (*Figs. 2–6*). This is supported by Ian Tait of Shetland Museum (pers. comm.), who estimates that c. 50% of the museum’s felsite implements are axeheads, 40% knives, and 10% belong to other tool categories. The most common ‘other’ tools are arrowheads and scrapers, many of which have



Fig. 2.
Felsite axehead
rough-outs from the
Beorgs of Uyea
(courtesy of Beverley
Ballin Smith).



Figs. 3–4.
Typical pointed-butted
stone axeheads
from Shetland
(courtesy of Ian Tait,
Shetland Museum);
No. 3 has a
traditional edge, and
No. 4 a splayed edge.



Figs. 5–6.
Two typical
Shetland knives
(courtesy of Ian Tait,
Shetland Museum).

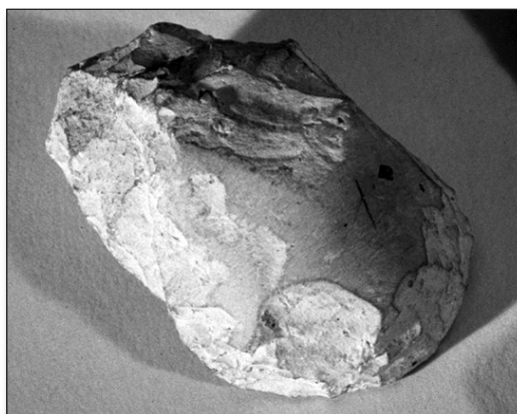


Fig. 7.
Polished felsite scraper
(courtesy of Ian Tait,
Shetland Museum).

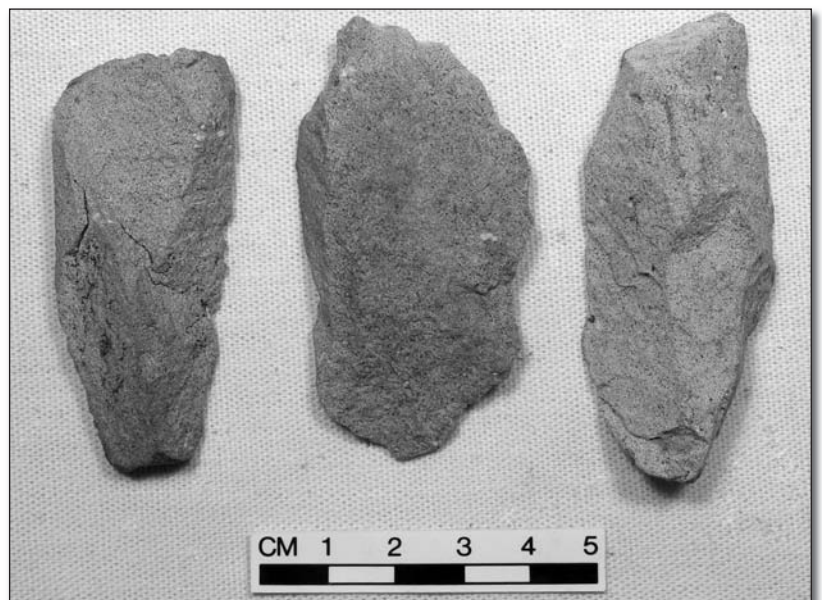
surviving polished surfaces, indicating that they are based on cannibalized polished axeheads. Interestingly, most polished scrapers have polished ‘ventral’ faces, rather than ‘dorsal’ faces (apart from the specimen in Fig. 7, which has two opposed polished faces).

Individual finds from the author’s surveys in 2007 and 2008 suggest that, in terms of assemblage variability, there may have been different practices in North Roe and outwith the peninsula. In 2007, a regular, elongated double-scraper (Fig. 8) was recovered from the Beorgs of Collafirth. This was probably manufactured on a large flake similar to the flakes produced as blanks for Shetland knives, that is, it was *not* based on a cannibalized axehead. West of Roer Water a small concentration of traditional flake and blade blanks (ie, not waste from the production of axeheads and knives) was retrieved in 2008 (Fig. 9). It is possible that only axeheads and Shetland knives, or rough-outs for these implements, left the North Roe quarry complex, but that within this area (and *not* leaving it) a proportion of the peninsula’s vast supplies of felsite was transformed into the traditional range of blanks and tools known from assemblages in other lithic raw materials.

Fig. 8.
Elongated felsite
double-scraper from the
Beorgs of Collafirth
(courtesy of Beverley
Ballin Smith).



Fig. 9.
Weathered blades and
blade-like flakes in
felsite from a location
west of Roer Water
(courtesy of Beverley
Ballin Smith).



Dating

The felsite objects, and thereby the felsite quarrying in North Roe, were traditionally dated to the later part of the Neolithic period, or even the Early Bronze Age, mostly through association with diagnostic pottery (e.g. Fojut 1986: 17–18; Turner 1998:50). This date is now challenged by typological evidence, as several of the island group’s leaf-shaped arrowheads are in felsite (e.g. Scott & Calder 1952:176). These arrowheads are usually associated with the Early Neolithic period, but unfortunately few of the common leaf-shaped sub-types are diagnostic (within the Early Neolithic period).

However, several of the Shetland pieces are kite-shaped, such as those from ‘Lerwick’ (ARC 662; Fig. 10) and Semblester in Sandsting (ARC 666). These points are usually associated with the later part of the Early Neolithic period, and with artefacts such as Seamer/Duggleby axes and polished flint knives. As typical Shetland knives closely resemble later Neolithic discoidal flint knives of Clark’s Type IV (Clark 1932:44), and as felsite maceheads are exceptionally rare, the author suggests that the main period of felsite exploitation spans the later part of the Early Neolithic and the earlier part of the Late Neolithic.

Although most of the operations in the area may be concentrated around the Early/Late Neolithic transition, the production of several distinct stone axe types (for example with plain rounded edges and with splayed edges; Figs. 3 and 4) indicates that at least the production of stone axes spanned a considerable length of time, although it is presently impossible to pinpoint this time-span precisely.

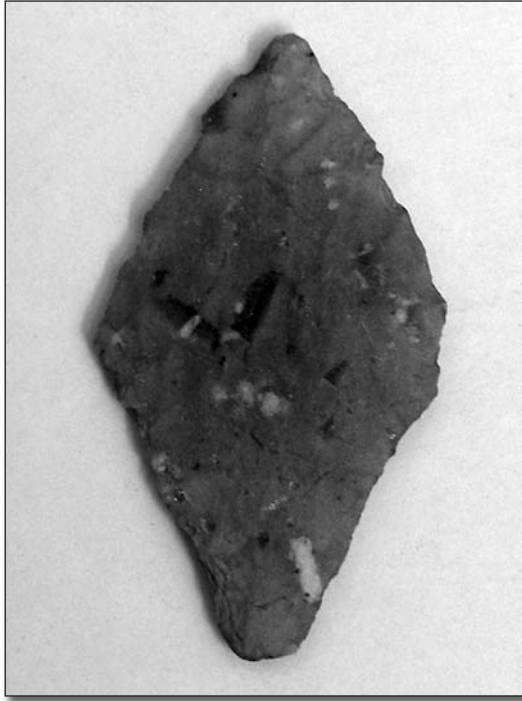


Fig. 10.
Kite-shaped arrowhead
in felsite
(courtesy of Beverley
Ballin Smith).

tailoring piles (Fig. 11) and workshops (Fig. 12). The former are long rows of crude quarrying waste following the original dykes (which would in many cases have been removed completely), but with the occasional *ad hoc* workshop attached to them, whereas the latter are relatively large concentrations of finer waste representing prolonged episodes of rough-out/preform production. Apparently, no final axeheads or Shetland knives were produced within the confines of the quarrying complex.

Table 3.
Schneiderman-Fox and
Pappalardo's (1996)
terminology and
nomenclature.

Fig. 11. (top)
The Beorgs of Uyea:
typical tailing pile.

Fig. 12.
Midfield:
the main workshop.

- 1 The quarry itself where material is extracted
- 2 The tailing pile, just below the quarry face, containing blocks of quarried material
- 3 The ore dressing, milling, or transition area, located below and within 50m of the quarry face, where large blocks are broken down for transport
- 4 The lithic reduction site above the quarry face or on a level terrace adjacent to the quarry face, where reduced blocks are further reduced into preforms or final tools.

Associated features

North Roe is rich in prehistoric as well as later features. For the time being, it is not possible to date all the features accurately, but in Table 2 a number of certain Neolithic features and likely Neolithic features are listed. These features include concentrations of quarrying waste, varying forms of shelters, and burial monuments.

- 1 **Quarrying waste**
 - 1.1 Tailing piles
 - 1.2 Workshops
- 2 **Shelters**
 - 2.1 Dwellings
 - 2.2 The Beorgs of Uyea working gallery
 - 2.3 Circular, oval and semi-circular, shelters
- 3 **Chambered cairns**

Table 2.
Certain, probable and
possible Neolithic
features in North Roe.

Quarrying waste

The concentrations of quarrying waste have been sub-divided and defined according to Schneiderman-Fox and Pappalardo's (1996) terminology and nomenclature (Table 3; see discussion in Ballin forthcoming b). However, it was found that, in the North Roe quarrying complex, the features represented such an overlap of functions that it would be more sensible to operate with only two categories, namely



The features at the Beorgs of Uyea are largely extensive tailing piles, but there are many small and large workshops dotted between and alongside them. The main concentration of quarrying waste in the Midfield area was initially perceived as an example of a 'detached' workshop, but later scrutiny has proven that it is actually a workshop located in the central part of a very faint tailing pile. Basically, these terms are defined on the basis of dominating activity within a particular location, and they do not signify activity exclusivity (e.g. quarrying vs rough-out production).

Shelters

This category of features includes two main types, namely actual dwellings, and rough shelters associated with the quarrying activities. A prehistoric house ruin (Fig. 13) is situated at the north-western corner of Roer Water, in the central parts of the peninsula, but its date is presently uncertain. It is an irregular cellular structure (Munro & Abercromby 1904:554), and in his correspondence with the author, Principal Inspector of Historic Scotland, Noel Fojut, wrote:

At the time of my visit, I formed the impression that the "homestead" site and associated walling pre-date the extensive growth of blanket peat, although I did not see conclusive evidence for this. I would tend to regard it as earlier than Iron Age, although messed about with later.

A number of finds from the author's surveys indicate that Roer Water would be a logical place to expect a Neolithic domestic site, as several felsite small finds have been recovered in the vicinity: in 2007, a well-executed elongated double-scraper was recovered from a sub-peat context next to a small burn near the Beorgs of Collafirth; and in 2008, a small concentration of felsite blades and flakes were recovered at the eastern end of Roer Water. As described in Ballin (forthcoming b), most small felsite implements recovered outwith North Roe appear to represent cannibalized axeheads, with a large proportion of these displaying polished surfaces, whereas these new finds from North Roe seem to represent ordinary domestic production.

During the 2008 survey, the author inspected a house ruin at the centre of Burriesness (Ketligill Head), which may also date to the Neolithic period. Although there are two almost certainly historical features situated in the immediate vicinity of this structure, its general layout and orientation suggest an earlier date.

Fig. 13.
The Roer Water
cellular structure
(after RCAMS
1946, 92).

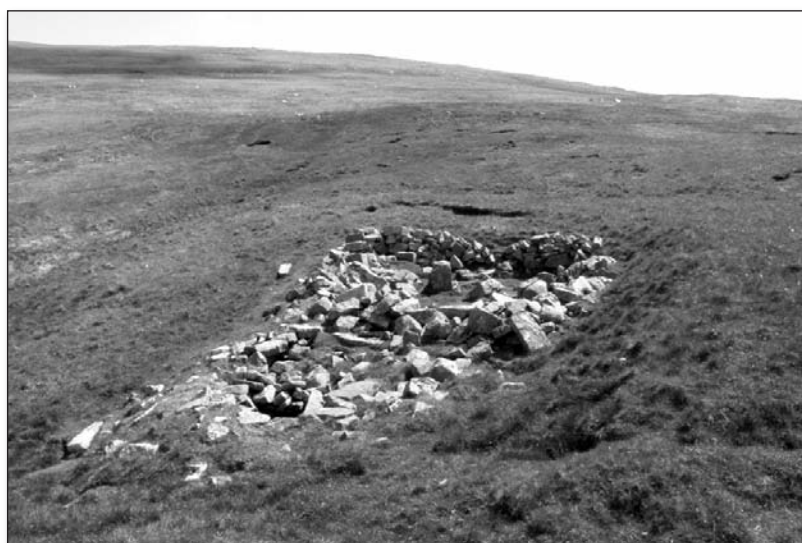
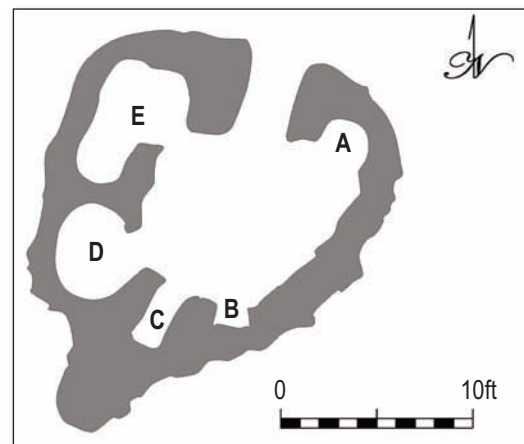


Fig. 14.
The Ketligill Head
segmented structure.

It is most closely related to a small group of Shetland Neolithic/Early Bronze Age houses, which include the houses at Stanydale, Ness of Gruting, Gruting School, Benie Hoose, Yoxie, and Wiltrow (Downes & Lamb 2000:120). All of these buildings are segmented structures, with a front-room, a rear room, and/or an innermost cell or recess, and they are generally orientated with the entrance facing east or, more commonly, south-east. The Ketligill Head structure appears to have had a large front room, a smaller rear room, as well as an innermost cell, and its entrance may have been facing south-east (Fig. 14).

The well-known lintelled-over 'gallery' (Fig. 15) is a small trench next to a surviving felsite dyke, which has had one lateral side strengthened by dry-walling. Finds from its floor suggest that limited reduction of felsite blocks took place within the feature, sheltering the felsite knappers from the harsh Atlantic weather at the exposed ridge of the Beorgs of Uyea. A number of small, mostly oval, features (Fig. 16) are probably similar shelters, but the absence of any entrances indicates that they were never



roofed. Although the location of these shelters within the core area of the felsite quarrying complex indicates that they are prehistoric features, it has still not been possible to date them safely.

Chambered cairns

Several megalithic burial monuments are known from North Roe, one of which is situated not far from the so-called 'gallery' in the general Beorgs of Uyea area (Scott & Calder 1952), with others located along the coast of the peninsula, as well as on Ronas Hill, Shetland's highest point (Calder 1964:Figs 12–13; Turner 1998:Fig. 13). Most likely, this part of Shetland harboured many more cairns, but on the boulder-strewn slopes of North Roe it will prove very difficult to identify any stone constellations as the remains of collapsed burial monuments.

Fig. 15. (top)
The Beorgs of Uyea
working gallery
(courtesy of
Carol Christiansen).

Fig. 16.
Oval Shelter
(courtesy of
Carol Christiansen).

The North Roe felsite quarries in their Neolithic setting

The key to a deeper understanding of the North Roe felsite quarrying is a firmer dating of the operations. Presently, it appears that most of the operations took place around the Early/Late Neolithic transition, but with the production of stone axeheads possibly spanning a longer period of time. The importance of this point is that, although the felsite waste presently visible in the North Roe area is an impressive spectacle, these remains may represent activities which took place over hundreds of years.

There can be little doubt that felsite was perceived as a special raw material by the Neolithic Shetlanders, and that it was dealt with in a special way. This is emphasized by a number of peculiarities, which defines felsite as more than just a traditional functional lithic/stone raw material (although it may be argued that probably all lithic/stone raw materials had *some* non-functional connotations in their prehistoric context; e.g. Topping 2005:Appendix 1):

- * As mentioned above, there is a clear difference between the forms of felsite preferred for the main felsite implements, axeheads and Shetland knives – the former implements are generally in rather plain raw material whereas the latter are in more spectacular forms of felsite.
- * In comparison to the known numbers of felsite axeheads and Shetland knives, very few everyday tools have been found in this raw material, mostly arrowheads and scrapers.
- * Outside North Roe, most arrowheads and scrapers appear to have been manufactured on damaged, cannibalized axeheads.
- * Apparently, only rough-outs for axeheads and Shetland knives ever left the North Roe quarrying complex.
- * New evidence seems to suggest that, within the North Roe peninsula, felsite was transformed into a more traditional range of blanks and implements.
- * There is a noticeable discrepancy between the amounts of visible felsite waste in North Roe (and it should be emphasized that much waste may still be 'trapped' below the area's thick layers of mainly post-Neolithic blanket peat), which probably runs in many thousands of tons, and the few hundred known axeheads and Shetland knives (primarily in the care of Shetland Museum, National Museums Scotland, the Kelvingrove Museum, and the Hunterian Museum).
- * Almost no felsite implements left Shetland in prehistoric times, just as very small num-

bers of exotic materials entered the island group (Shetland is for example the only part of Scotland from which no pitchstone artefacts have been recovered; Ballin 2009).

The apparent lack, or scarcity, of domestic settlements in North Roe may be an artefact of the area's generally thick cover of blanket peat, if for example domestic sites were concentrated in the low-lying areas around the peninsula's lochs. The feature at Roer Water is a potential Neolithic structure, and it is an obvious target of future surveys in North Roe.

In concert, the above facts suggest that:

- * Felsite was indeed a special raw material, and the use of it was subjected to a number of restrictions, or even taboos. In general, it could only be used for certain types of implements, although it was 'permitted' (probably in well-defined circumstances) to transform these objects into other functional implement types.
- * Due to its status as the source of this special raw material, North Roe was a special place, and within this area, it appears to have been accepted that felsite was used more liberally, that is, for more tool forms than simply axe-heads and Shetland knives.
- * Shetland, which may in Neolithic times have formed one social territory, was probably perceived as a special place *in toto*, at least by the islanders themselves, and exchange in lithic/stone raw materials in and out of Shetland was heavily restricted (for example, no pitchstone in, no felsite out).

While the presently available evidence does not allow more detailed characterization of the North Roe quarrying operations, it is possible to crudely sketch how the felsite procurement may have been organized.

Although, as touched upon above, most lithic/stone raw materials were associated with some symbolic (frequently totemic) values by their prehistoric users, raw materials could be perceived largely in a functional light or largely in a symbolic light. It does appear, for example, that in Papua New Guinea (White & Modjeska 1978) axeheads were primarily viewed as a utilitarian commodity, and the raw material for these axeheads had, as a consequence, few symbolic connotations. For this reason, the access to the raw material was largely free although, as in most tribal contexts, restricted by the presence/absence of kinship ties. In contrast, the North Roe felsite seems to have been viewed much more in a symbolic light, where

different forms of felsite were associated with different values, leading to stringent rules about how the different forms of felsite could be used, by whom, where, and (assumably) when.

In this light, it is highly likely that the procurement of felsite was organized in a way similar to the one suggested by Topping (2005:69) for the extraction of flint from the mines at Grimes Graves in south-east England. His proposal, which was inspired by research into native American raw material extraction in the United States, includes the following sequential elements:

- 1) cleansing rituals,
- 2) offerings,
- 3) extraction,
- 4) post-extraction prayers and offerings,
- 5) artefact production,
- 6) ceremonial use of (some) artefacts, and
- 7) rites of renewal.

Ethnographic parallels (Topping 2005:Appendix 1) also suggest that women generally had restricted access to extraction sites and thereby also to the main quarrying areas of North Roe. This may explain why there are no domestic settlement sites in the immediate vicinity of the outcrops.

Future perspectives – strategy

In Ballin (forthcoming b), a full future felsite project was outlined, including a full survey (mapping) of the North Roe area, definition and detailed characterization of the individual sites (tailing piles/workshops), sampling and petrographic characterization of raw material from all sites, and petrographic characterization of artefacts from the Shetland Museum.

In the shorter term, however, it is more important to 1) complete the initial survey of all North Roe outcrops (Gilgordie Brogs, Grut Wells, Grud Burns and, not least, the area around the Roer Water structure), as well as 2) excavate two type sites, one tailing pile and one workshop. It is suggested that a trench should be excavated across one of the main Beorgs of Uyea tailing piles and that the main workshop in the Midfield area should be excavated (Figs. 11–12). In both cases, the work ought to include physical description of the two sites, and characterization/quantification of the finds (types of waste, rough-outs, final tools, etc.). This would allow a discussion as to how work was organized within these different site types and whether, or to what degree, they represent processual specialization.



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Misty mountain hop:

Prehistoric stone working in south-west Wales



Abstract

A wide range of rock sources were exploited in south-west Wales from the ninth millennium BC onwards, initially based on material available on local beaches but from the fifth millennium BC increasingly focused on specific outcrops, including those defined as Groups VIII, XIII, and XXIII. Attention is directed to the products as well as the sources, arguing that it was the meanings that attached both to particular kinds of stone, and the ways stone was used, that were important to prehistoric people. It is suggested that traditional Western polarized distinctions between animate and inanimate are inappropriate, and that in prehistoric times stone was considered to be 'alive' and active in maintaining the well-being of individuals and the community.

Introduction

Generously provided with a wide range of distinctive rock types around its coast, along its river valleys, and over the misty mountains of its upland interior, outcrops across south-west Wales were exploited by communities living in the area from at least the ninth millennium BC. This overview focuses on the area covered by the historic county of Pembrokeshire, essentially a wide peninsula of land extending westwards into the Irish Sea defined on the north by Cardigan Bay and on the south by the Bristol Channel (Bowen 1957). Structurally and visually dominated by the Preseli Hills rising to 536m at Foel Cwmcerwyn in the north, relatively low-lying plains surround Haverfordwest, Narberth, Carew, and Pembroke to the south. Numerous islands off the headlands of St David's and St Bride's were perhaps connected together or with the mainland during periods of lower sea-level in early prehistory. Rivers of the southward-draining Cleddau catchment, and the westward-draining Nevern catchment, connect the coast with the interior. The position of south-west Wales within the Western Seaways provides important maritime links with Ireland, lands bordering the Irish Sea, Cornwall, and the Atlantic coastlands of western France.

Geologically, south-west Wales is extremely diverse (George 1970). Pre-Cambrian lavas, tuffs, granites, felsites, and diorites outcrop around St David's, Haystack, Roch, Talbenny, Johnson, and Benton, beside which are extensive Cambrian sandstones, mudstones, and shales. To the north of Haverfordwest Ordovician shales and mudstones dominate the landscape, while southwards there is a neat succession of sedimentary rocks comprising Silurian shales, Devonian Old Red Sandstones, Carboniferous limestones, Millstone Grit, and Coal Measures exposed along an eroded east-west orientated asymmetrical anticline. Numerous intrusive sills of igneous rock (mainly dolerites and gabbros) from a common magma source which emerged during Ordovician times, piercing the existing Cambrian and Ordovician sedimentary rocks and causing localized metamorphism such as the formation of slates and meta-mudstones (Evans 1945; Bevins *et al.* 1989). Most of these sills have a roughly east-west orientation and because of their resilience remain visible in the landscape as ridges topped by scattered splintered outcrops locally known as 'carns'.

During cold stages of the Pleistocene, south-west Wales was variously affected by glaciations

that individually and collectively contributed to the shaping of the landscape and the distribution of stone types beyond their source outcrops (McCarroll 2001). An Anglian, or pre-Anglian glaciation, known as the Irish Sea Glaciation, enveloped the area with ice-sheets extending southwards to the Cornish coast and eastwards to the Severn Estuary (Clark *et al.* 2004:62; Bowen 2005). Later ice-sheets generally avoided the area, although tundra and peri-glacial conditions during cold periods followed by fluvial action during periods of global warming added to and shifted accumulations of glacial tills and boulder clays from earlier times. Localised movements of rock debris deposited as valley trains that look like rivers of stone can be recognized, while medium-distance movements of erratics southwards have been recognized and mapped as substantial boulder trains (McCarroll 2001; Bowen 1982, 2005).

Prehistoric people were not so much interested in the geology, lithology, petrology, and geomorphology of the stone they encountered in their landscape. Rather, it was the symbolic and socially determined qualities prompted by associated stories, myths, and legends relating to its source, colour, texture, workability, appearance, associations, and connotations that gave stone power. In the following sections, attention is first directed to the early uses of stone, followed by a consideration of the exploitation of distinctive sources through the fourth and third millennia BC and beyond. Throughout, the net is cast widely as traditional distinctions between 'portable' artefacts and blocks used for the construction of 'fixed' monuments are more blurred than often thought.

Stone exploitation in the fifth Millennium BC and before

At the early Mesolithic occupation site of The Nab Head I, dated to 8623–8284 cal BC (OxA-1495: 9210±80 BP) and 8566–8207 cal BC (OxA-1496: 9110±80 BP), 98.8% of the recovered lithic industry was beach flint, supplemented by easily flaked shingle such as tuff, rhyolite, and cretaceous greensand abundant in Irish Sea Drift deposits and also available on local beaches (David 2007:97). In addition, however, a kind of blue-grey shale identical to material available at St Bride's Haven about 1km along the coast to the east was used to make small perforated beads. Nearly 700 such beads are known, 64 of them from excavations directed by Andrew David in 1980. The blanks used in manufacturing the beads were usually

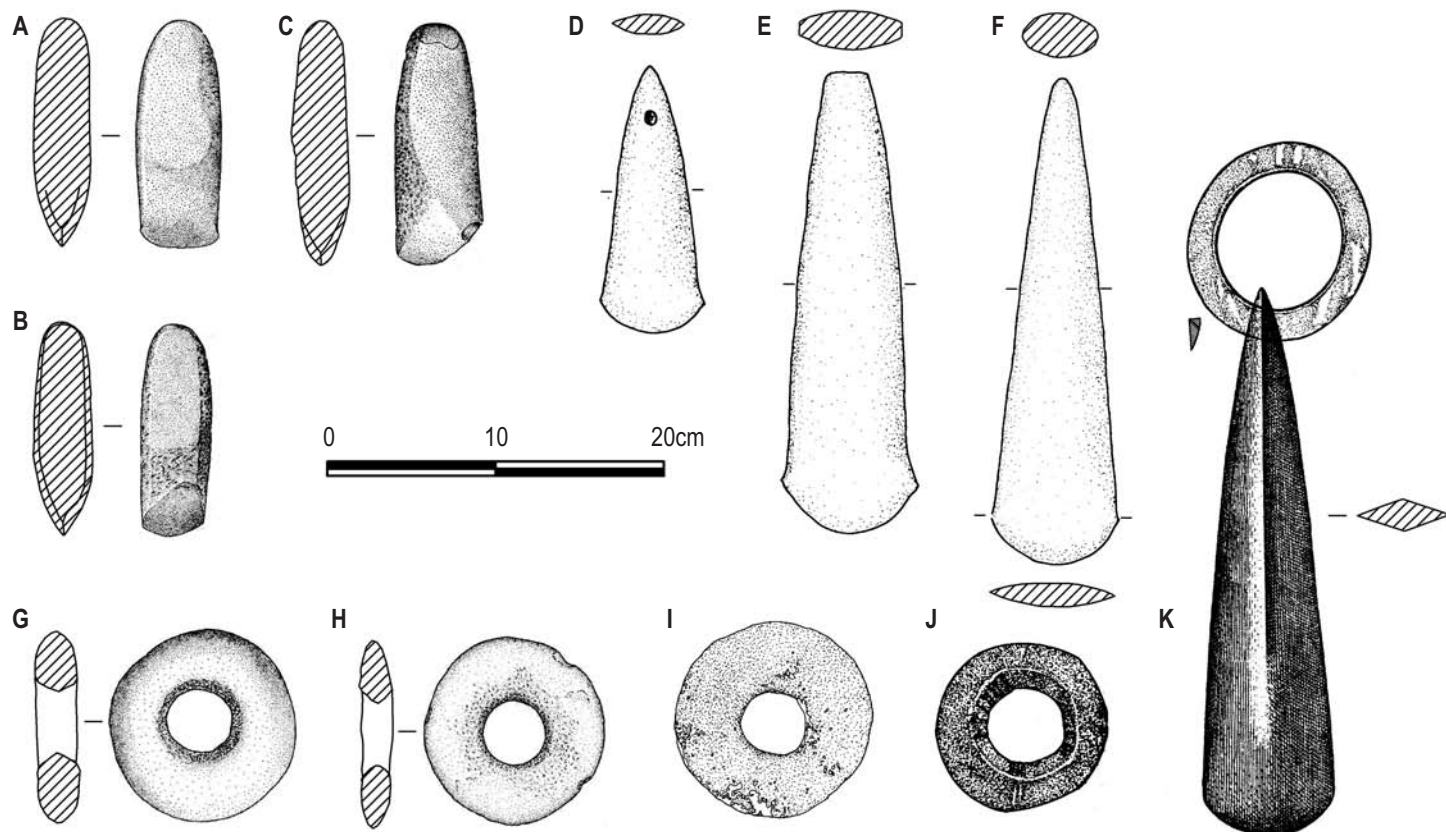


Fig. 1.

Fifth millennium BC
axes and rings.

A–C and G–H:
The Nab Head,
Pembrokeshire;

D–F:
Brittany;

I:
La Garenne, Fleurigne,
Brittany;

J:
La Championniere,
Gévezé, Brittany;

K:
Mané er Hroëck,
Locmariaquer, Brittany.

[A, B, C, G and H after
David 2007, figs 6.13 and
6.19; D, E, F after Patton
1993, fig 5.3; I, J and K
after Herbaut and Pailler
2000, figs 121 and 122]

oval in shape, typically 2–3mm thick; they were perforated by drilling a U-shaped hole cut from one side only. Unperforated blanks suggest that the site was a production centre, an interpretation confirmed by the presence of worn flint drill-bits. Comparable beads have been found singly at Waun Fignen Site 6, Glamorgan, and at Freshwater East, Linney Burrows, and Palmerston Farm, all in Pembrokeshire (David 2007:105–9). Some kind of exchange network radiating out from The Nab Head even as early as the ninth millennium BC may be suspected; an Old Red Sandstone bead found at the site perhaps suggests return exchanges from people living away to the east. Other objects of shale from The Nab Head include a carved phallus or amulet (David 2007:109–11).

A second later occupation site on The Nab Head dates to between 6415–6059 cal BC (OxA-860: 7360±90 BP) and 5371–4933 cal BC (OxA-861: 6210±90 BP). Here again local beach-flint was the main raw material used, together with small quantities of igneous rock and Greensand chert. More unusual were a number of pecked and ground stone axes/adzes and perforated and ground stone rings (David 2007:150–6). Three axes have a clearly defined symmetrical working edge ground from both faces (Fig. 1A–C). The blades are gently curved and flared to give a very slight but distinctive

flange on either side. The bodies are oval in cross-section, tapering to a rounded butt. The surfaces are locally ground or polished flat. They seem to have been made from beach pebbles judiciously selected for their outline, density, and size which were then pecked and ground into shape. All appear to be medium-grained basic igneous rock of the kind well represented on beaches in west Wales. A fourth axe from The Nab Head made of sandstone is similar in form.

Comparable specimens in a variety of rock types whose sources are also thought to lie in north Pembrokeshire have been found at Bwlchyddwyallt (Burrow 2003:fig 8.1), Scalby Moor near Dale (David 2007:150), Brunt Farm near Dale (David 2007:152), and perhaps Stackpole Warren (Benson *et al.* 1990:226–7) and Segontium, Gwynedd (Burrow 2003:fig 8.4). Ground and polished stone axes have been found in some quantity in later Mesolithic sites in north-east Ireland (Woodman 1978:108–14), but they show little similarity in shape or form to those from south-west Wales.

Far more interesting, and potentially more significant, are similarities with the early jadeite axes from Europe, especially those of the Saint-Michel, Rarogne, Pauilhac styles with slightly flared blades that are thought to date to between 5000 and 4500 cal BC (Sheridan 2007:

26), and also some axes from northern France which share the distinctive flared blade (*Fig. 1D–F*). As if to support these continental ties, the other unusual class of object from The Nab Head is the perforated stone disc or ring. Three have been recovered (David 2007:154), all made from stone obtainable on local beaches (*Fig. 1G and H*). Although broadly similar to the ubiquitous pebble-hammers or shafthole adzes (Roe 1979), these examples have large central perforations and are more like the stone rings and bracelets of fifth and fourth millennia BC date from northern France (Auxiette 1989; Herbaut & Pailler 2000; *Fig. 1.I and J*) which in Brittany occur in association with axes in burial deposits as what many consider artefact ‘sets’ (*Fig. 1.K*) symbolically representing biological reproduction (Patton 1993:31–2 and 110–13).

Finds from The Nab Head clearly establish the use of dolerite for the manufacture of axes in the fifth millennium BC. Equally early is the exploitation of silicified tuff identified as petrological Group VIII with a source in south-west Wales, flakes of which have been found at in a scatter of late Mesolithic worked flint and stone below a round barrow at Trywn Du, Aberffraw, Anglesey (Ireland & Lynch 1973).

Fourth and third millennia BC stone working

That a variety of igneous, sedimentary, and metamorphic rock types were being selected for the manufacture of prestige items in early post-glacial times in south-west Wales is well evidenced at The Nab Head, establishing a practice that continued through into the fourth and third millennia BC. Two formally recognized Petrological Groups, VIII and XIII/XXIII, have identified sources in south-west Wales, but it is increasingly clear that the Groups neither fully reflect the geological variation in the particular source outcrops, nor do they represent the full range rock being exploited and worked in the area.

Group VIII

Group VIII was defined in 1941 when it was described as a light-coloured, compact, fine-grained, igneous rock that in thin-section consisted of an even and finely-textured micro-crystalline mosaic of quartz and possibly feldspar with scattered, irregular non-homogeneous accumulations of leucoxene, best classified as a silicified tuff (Keiller *et al.* 1941:63). The definition was based on three specimens from Keiller’s excavations at Windmill Hill, Wiltshire.

By 1951 (Stone and Wallis 1951:122–6), five further examples had been thin-sectioned (including two more from Windmill Hill) and the proposal made that the source lay amongst the volcanic material from the Llanvirn series of Lower Ordovician rocks outcropping on Ramsey Island and around Mountjoy on the adjacent mainland near St David’s. Possible confusion with fine silicified tuff from the Lake District (separately defined as Group XI) was recognized, and appropriate distinctions made where necessary, but this did not redefine the source of a flake and an axe rough-out of Group VIII rock discovered at the Pike O’Stickle axe factory site in the Lake District. These finds have variously been interpreted as evidence for contact between the two areas or the presence of another source of Group VIII-like rock in the Lake District (Stone & Wallis 1951:122; Ritchie 1953; Fell & Davis 1988:73; Bradley & Edmonds 1993:72), of which the former now seems most likely. By 1962, the corpus of identified Group VIII material had risen to 14 specimens – nine axes and five flakes – while an axe from Vowchurch, Herefordshire, had been designated a variant styled Group VIIIa (Evens *et al.* 1962:217). One further axe was added in 1972 (Evens *et al.* 1972:242), while studies of distribution patterns seemed to reinforce the proposed source in south-west Wales with an essentially regional distribution (Cummins 1979:fig 4; 1980:fig 1; Darvill 1989:fig 7). Houlder’s (1988) listing of sampled implements from Wales itemised 66 examples in Group VIII rock, including 56 axes, while the national distribution map based on 119 find-spots in the same volume showed a wide spread of finds across Wales and southern England (Clough & Cummins 1988:272).

At more or less the same time as the distribution of products was becoming clear, Andrew David and George Williams identified two production sites utilizing stone recognizably of Group VIII in south-west Wales (David & Williams 1995). Both were discovered through fieldwalking and explored through test-pitting and small-scale excavation. At Glyn-y-Fran, Llanfyrnach (SN 186307), finds from fieldwalking included retouched flakes, seven complete or fragmentary axe roughouts, and hammerstones. Worked flint was also found. The second site at Glandy Cross (SN 143 266) lay west of a cluster of ring ditches, henges, a stone circle, and standing stones best interpreted as a regional ceremonial centre of the third millennium BC (Kirk & Williams 2000). Fieldwalking brought to light more than 200 pieces of stoneworking debris, including retouched





Fig. 2.

Carn Alw, Pembrokeshire.

A:

View of the hill
looking north;

B:

Large raised boulder
surrounded by a low bank
within the enclosure on
the west side of the hill.

Scale totals 2m.

[Photographs by
Timothy Darvill:
SPACES]

flakes, axe roughouts, and hammerstones. In both cases the rock type being worked was identified in the hand specimen as rhyolite, which thin-sections and chemical analysis matched with material previously identified as Group VIII. Both sites were the result of working either glacially deposited erratics or blocks of stone transported to sheltered locations from the parent outcrops some distance away. Both practices are well-known in relation to the working of Group VI rock in the Lake District, for example at Thunacar Knott and Stake Beck (Bradley & Edmonds 1993:105–30; Claris & Quatermaine 1989:12: Site Type D) and emphasize the variety of working practices adopted. Detailed chemical analysis of 12 rock samples from Glyn-y-Fran and Glandy Cross by Olwen Williams-Thorpe at the Open University (OU) showed that the likely source of the erratics was within or near the Preseli Hills, most probably the outcrops at Carn Alw on the north side of the Preseli ridge.

Carn Alw (SN 138337) is a distinctive hill (Fig. 2A) heavily used in prehistory. On the west side of the dominant crag is an enclosure

defined by a stout stone rampart, with an elaborate defended entrance to the north-west and a rather fine *chevaux-de-frise* on the south-western flanks (Mytum & Webster 1989). Close examination by the present author and Geoff Wainwright as part of the SPACES project (Darvill & Wainwright 2002a) suggested the presence of rough pre-rampart walling perhaps indicative of an earlier phase of enclosure. Abundant stuck flakes of rhyolite were noted in crevices and sheltered areas on the east side the outcrops, but most extraordinary is the large block of stone in the interior (Fig. 2B). This has clearly been lifted out of the ground, propped on short stone supports, and surrounded by a low earthen bank as if to indicate its special properties; arguably, the stone has also been shaped. Less than 3.5km to the north-west is a possible *polissoir* immediately north of the denuded simple passage grave of Bedd yr Afanc (Darvill *et al.* 2003:8–9).

Isobel Smith included Group VIII products within the early phase of axe production (Smith 1979:14), an attribution borne out by the presence of a Group VIII axe fragment along with three other pieces from other sources in a pit at Coygan Camp, Carmarthen shire (Wainwright 1967:17–18). Hazelnut shells from the pit provided a radiocarbon date of 3982–3637 cal BC (NPL-132: 5000±95 BP). Further afield many of the known pieces are potentially of later fourth or third millennium BC date, although their fragmentary state suggests that some finds represent the remains of long-broken implements. In Cornwall, a piece of worked silicified tuff closely related to Group VIII material was found in a pit within a possible house-structure at Carn Brae (Smith in Mercer 1981: 153). At Windmill Hill, Wiltshire, an axe fragment and flake came from the upper ditch fills, a flake from the interior, and two axe fragments from the ditch of a bell barrow on the hill-top (Smith 1965:113–4). At Hambledon Hill, Dorset, a small flake of Group VIII rock was found in the upper fill of the Outer East cross-dyke (Mercer & Healy 2008:632). Also from Dorset but of slightly later date is the Group VIII axehead associated with a flint axe on the west side of the entrance into the Wyke Down Henge (Barrett *et al.* 1991:101). Cremated human bone, animal remains and Grooved Ware pottery were also present in the pit indicating a third millennium BC date for the deposit.

More difficult is the material from Llandegai, Gwynedd. Excavations by Chris Houlder in 1966–67 revealed what was believed to be a slab of Group VIII rock used as an axe polisher

before being deposited in a cremation pit dated to 3360–3013 cal BC (GrA-22954: 4480±50 BP) within the formative henge designated ‘Henge A’. However, more recent examinations suggest that the rock is not an especially close match for Group VIII, and may be of Lake District origin (Lynch & Musson 2004:45).

Groups XIII and XXIII

This complicated series of rock types has been the subject of much study since H H Thomas identified the link between rock outcrops on the Preseli Hills and the some of the so-called ‘Bluestones’ at Stonehenge, Wiltshire (Thomas 1923). In the first report of the South-Western Group of Museums and Art Galleries sub-committee on the petrological identification of stone axes, just one of the types of stone identified by Thomas was singled out for attention and referred to as ‘Presely Stone’: a ‘beautiful and distinctive rock’ with white or pinkish spots composed of irregular crystals and crystal growths of oligoclas-albite feldspar generally classified as spotted dolerite popularly referred to at the time as Preselite (Keiller *et al.* 1941: 64–5). As well as being used in large blocks for pillars at Stonehenge, there was also evidence that axes and shaft-hole implements were made of this same rock, the main sources of which were identified as Carn Menyn and Carrig Marchogion on the eastern end of the Preseli Ridge. Reporting the discovery in 1944 of a Preselite axe-hammer found at Fifield Down, Wiltshire, J F S Stone provided an important review of other findspots of this material in Wessex (Stone 1950). In 1951, Preselite was formerly defined as Petrological Group XIII, and eight axes, a macehead, and an axe-hammer catalogued (Stone & Wallis 1951:128–9). Two of the axes listed were from County Antrim in Ireland (Keiller 1936), but later reclassified as ungrouped dolerite and greenstone (Evens *et al.* 1962:219). Ironically, recent work by the Irish Stone Axe Project has suggested that some of the porphyritic dolerite axes found in Ireland may in fact be related to Group XIII and derived from the same source, although further analysis is needed to confirm this (Cooney & Mandal 1995:973; 1998:175). By 1972 no less than 20 identifications of Group XIII material had been made amongst samples studied in south-west England, the majority being pieces of rock rather than recognized implements (Evens *et al.* 1972:246). At about the same time Professor F W Shotton examined a number of large stone axes from north-west Pembrokeshire and in so doing defined Group XXIII as a spectrum of dolerites outcropping between St David’s Head

in the west and the Preseli Hills in the east. Geologically these sources ranged from graphic pyroxene granodiorite (XXIIIa) through to quartz dolerite (XXIIIb), a spread which embraced the spotted dolerite/Preselite (Group XIII) as the spotted *facies* within the broad petrological and geographical range of Preseli dolerites thus recognized as Group XXIII (Shotton 1972). The distribution maps published by Clough and Cummins (1988:276 and 282) emphasized the extensive if thin scatter of petrologically identified Group XIII/XXIII products across Wales and southern and eastern England, with a complete axe from Watcarrick in Eskdalemuir, Dumfries-shire, Scotland (Truckell 1953; Livens 1961:70: DUM8) as something of an outlier.

Since the late 1980s a campaign of study by Richard Thorpe and Olwen Williams-Thorpe and colleagues based in Department of Earth Sciences at the OU has focused on the geological origins of the Stonehenge Bluestones with a view to proving that glacial rather than human agency was responsible for the movement of stones from south-west Wales to Salisbury Plain (Thorpe *et al.* 1991; and cf. Kellaway 1971, 2002). Attractive as such theories might seem to anyone afraid to accept the transformative role of prehistoric people in relation to their environment, and the power of belief systems in fuelling the conspicuous consumption of energy and social capital on monument building, the reality is quite different. H H Thomas himself was adamant that glacial movements were not responsible for the transportation of the Bluestones (1923:252–4), a view confirmed through the work of later generations of geologists, geomorphologists, and glaciologists (Scourse 1997; Green 1997; Bowen 2005:147–8) although stubbornly disputed by a few (e.g. John 2008). Importantly, the high quality analytical work undertaken by the OU team, promptly and fully published, provides a wealth of substantiated insights that actually serves to expand our understanding of the way prehistoric people selected, transported, and used particular kinds of rock.

Focussing first on the spotted dolerites, the OU team found that of the 45 extant ‘Bluestones’ at Stonehenge, some 28 (62%) were spotted dolerite. A petrological study by Rob Ixer of spotted dolerite samples from Carn Menyn and Stone 61 in the Bluestone Horseshoe at Stonehenge showed that all were ‘*very similar and consistent with the suggestion that they all come from the same locality*’ (in Thorpe *et al.* 1991:152; Ixer 1997). Seven samples from pillars in the Bluestone Horseshoe were core-sampled and subject to detailed geochemical analysis



Fig. 3.

Carn Menyn,
Pembrokeshire.

A:

Carn Menyn looking
north;

B:

Natural rock outcrops
near the western end of
the Carn Menyn ridge.

[Photographs by
Timothy Darvill:
SPACES]



which showed them to have very similar chemical compositions that match closely samples obtained from Carn Menyn, Carn Gyfrwy, Carn Breseb, Carrig Marchogion, and Carn Goedog in the eastern Preseli Hills (Thorpe *et al.* 1991:135). All of these carns lie within a restricted area c.3.5km by 0.5km in extent, and are mainly intervisible. Intensive walk-over surveys and surface inspections as part of the SPACES project show that of these possible sources only Carn Menyn has archaeological

evidence for stone extraction in pre-modern times: the highest part of the outcrop is enclosed by a stone wall, burial cairns lie on and around the outcrops, and there is a scatter of abandoned pillar stones in this area (Darvill *et al.* 2003:8–11; 2004:105–9; 2005:17–20; 2006: 100–5). Because of the nature of the outcrops (Fig. 3), quarrying in a conventional sense is unnecessary because blocks can simply be prized from outcrops or lifted from spreads of tumble.

Beyond the immediate vicinity of Stonehenge, spotted dolerite has been recognized from more than twenty sites across Britain, mainly dating to the third millennium BC or later. A small concentration of eight stone implements including axes, battle-axes, and a macehead in central southern England are indistinguishable from the spotted dolerites used at Stonehenge, and probably come from the same source (Williams-Thorpe *et al.* 2004; 2006:42). They may have been transported directly from Wales, but more likely they were manufactured at or near Stonehenge using pieces broken off the pillarstones at the monument. Abundant working waste in the form of flakes, rough-out axes, and other semi-complete items was found in the central part of the site (Cleal *et al.* 1995:375–90), while investigations around Stones 96 (The Heelstone) and 97 brought to light 6kg of spotted dolerite debris (Pitts 1982:115). By contrast, the spotted dolerite axes, battle-axes and axe-hammers known from Wales and other parts of England and Scotland show a variety of chemical signatures suggesting a diverse range of sources amongst outcrops in the Preseli Hills or perhaps elsewhere in the British Isles (Williams-Thorpe *et al.* 2006:44).

Flakes and larger blocks of spotted dolerite are also known in central southern Britain beyond Stonehenge. These almost certainly derive from the looting of the Stonehenge pillarstones, which began at an early date. A large piece of spotted dolerite found in the ditch of the Heelstone was perhaps originally part of a shaped monolith (Pitts 1982:fig 25), and more than a dozen smaller pieces have been found in the surrounding landscape (see Stone 1948, 1950; Pitts 1982:125–6; and Thorpe *et al.* 1991 for lists). Further afield the piece found by William Cunnington inside the long barrow known as Boles Barrow some 19km to the north-west of Stonehenge is perhaps the best-known and is often cited as evidence for the early arrival of spotted dolerite in Wiltshire. As I have argued elsewhere, however, this piece most likely lay within a deliberate chamber blocking deposit, a practice common at long barrows across Britain in the late third millennium BC and wholly consistent with early stone-robbing at Stonehenge (Darvill 2006: 126). It seems fairly certain that the block of spotted dolerite once in the garden of Heytesbury House, now in Salisbury Museum, was the stone found by William Cunnington in Boles Barrow (Cunnington 1924), although it may just possibly be another block taken directly from the monument. Removing pieces

of Bluestone from Stonehenge as talismans, lucky charms, or because of perceived health-giving properties is a tradition extending back into ancient times and might account for the fragment of Group XIII stone in the upper fill of Middle Ditch segment IB at Windmill Hill which Isobel Smith in her usual understated way noted was ‘difficult to interpret as part of an axe’ (1979:19; see also Smith 1965:114 and Whittle *et al.* 1999:340). A small piece of spotted dolerite now in Avebury Museum was found on the top of Silbury Hill during excavations in 1969 (Atkinson 1970:314; Whittle 1997:21), while another found near the West Kennet long barrow (Williams-Thorpe *et al.* 2004:373) was perhaps lost en route to the ceremonies that must have accompanied the filling of the chamber at this well-known tomb.

In south-west Wales, spotted dolerite was used in the construction of monuments from the early fourth millennium BC onwards, although the stones in question could in some cases have been erratics rather than blocks brought from outcrops along the Preseli Ridge. At Pentre Ifan some of the orthostats of the portal dolmen appear to be of spotted dolerite (*contra* Thorpe *et al.* 1991:117), but especially important because of the similarities in date and form with Stonehenge are the stone circles and ovals. At Gors Fawr at least half of the 16 pillars are spotted dolerite, as too the pair of stones forming outliers 400m to the north-northeast (Thorpe *et al.* 1991:116; Darvill & Wainwright 2002b:21–3; 2003:18–22). One of the two remaining stones out of the 17 depicted by William Stukeley at Meini-Gwyr is of spotted dolerite, while all 17 of the pillars in the stone oval at Bedd Arthur are spotted dolerite (Darvill & Wainwright 2002b:19–20 and 23–6; 2003:22–30).

Spotted dolerite was also widely used in medieval and later times in south-west Wales. Nancy Edwards (2007) has recorded 19 cases amongst the early medieval inscribed stones from Pembrokeshire, nearly 70% of them cross-carved slabs used as monuments and markers associated with early monastic sites. Many small-scale workings involving the use of drills and iron wedges have been recorded around Carn Menyn (Darvill *et al.* 2005:17–20; 2006: 100–101), and large relatively recent quarries are visible on the south side of Carn Menyn, the south-east side of Carn Breseb, and the north side of Carn Goedog. Although rarely used in domestic architecture, the Cana Independent Chapel built in 1856–7 and the Bethel Baptist Chapel in Mynachlog Ddu built in 1875–7 were substantially constructed from

spotted dolerite. Gateposts and other field-furniture were also made in spotted dolerite and can still be found in the Preseli landscape and beyond. In Wiltshire, dolerite from Stonehenge does not seem to have been used in local buildings, although William Long (1876:76) notes a local tradition that some stone from Stonehenge was used in the construction of West Amesbury House and its surrounding parkland, and commentators from Stukeley onwards record people chipping pieces off as souvenirs (Stukeley 1740:5; Chippindale 2004: 72–3).

Much less is known about the early use of non-spotted dolerites within Group XXIII. Shotton listed 16 axes and 7 perforated implements from Wales and the Marches (1972) to which a few additions can now be made. Dated examples are rare, but one of the two polished stone axes found at Clegyr Boia, Pembrokeshire, is Group XXIIIb and may date to the fourth millennium BC (Williams 1952:23; Shotton 1972:90). A fragment of stone axe from the working site at Glyn-y-Fran, Pembrokeshire, was a dolerite of the kind that outcrops around St David's Head (David & Williams 1995:460) suggesting some overlap in the use of this rock and the production of Group VIII items. It is possible that the three non-spotted dolerite pillars extant at Stonehenge derive from the same source outcrops as some or all of the other implements; analysis of samples from Stones 44 and 45 led Thorpe and colleagues (1991:139–40) to suggest a source at Carn Ddafad-las on the extreme eastern end of the Preseli Ridge between Carn Menyn and the great hilltop enclosure of Foel Drygarn. Unspotted dolerite is also used in many monuments in south-west Wales but none have been analysed to determine likely source outcrops. Clearly, there is much scope for further collaborations between archaeologists and geologists in order to track more of these poorly understood 'grouped' and 'ungrouped' rocks back to their sources.

Other utilized rock sources

The two recognized 'Petrological Groups' were by no means the only rock types from the area exploited in prehistoric times for artefacts and monument building. In addition to the spotted and unspotted dolerites there are at least a half a dozen other types of stone represented at Stonehenge whose origins lie in south-west Wales. Their existence and basic petrology was well recognized by H H Thomas (1923:242–5) while more recent work by the OU team has provided detailed chemical analysis and sug-

gested possible source outcrops. It was because of the variety of imported stone at Stonehenge – sometimes referred to as the 'foreign stones' to distinguish them from the local sarsens – that the generic term 'Bluestone' was brought into widespread usage by William Gowland at the beginning of the 20th century (Gowland 1902). Ongoing research by Rob Ixer on finds from the 2008 excavations at Stonehenge by the present author and Geoff Wainwright (Darvill & Wainwright 2009) and the Stonehenge Riverside Project (Parker Pearson *et al.* 2006) will further refine the corpus of stone types represented, and determine their relative abundance, but among the non-dolerites represented at Stonehenge the following are recognizably important:

- Rhyolitic ignimbrite 1.* Bluish colour with dark clasts up to 15mm long (e.g. Stonehenge Stone 38). North Pembrokeshire, possibly from Carn Clust-y-ci near Carn Ingli (Thorpe *et al.* 1991:142).
- Rhyolitic ignimbrite 2.* Bluish colour with elongated and rounded clasts (e.g. Stonehenge Stone 40). North Pembrokeshire (Thorpe *et al.* 1991:106).
- Rhyolitic ignimbrite 3.* Blue-grey fabric with banding and vesicles; flattened clasts (e.g. fragments from the Heelstone ditch). North Pembrokeshire, possibly Carn Alw (Thorpe *et al.* 1991:142).
- Rhyolitic lava.* (e.g. Stonehenge Stones 46 and 48). North Pembrokeshire possibly from the Fishguard Volcanic Group near Strumble Head or Abereiddi Bay (Thorpe *et al.* 1991: 143).
- Altered volcanic ash.* Dark olive-green (e.g. Stonehenge Stone 33e, 33f, 34c). North Pembrokeshire (Thorpe *et al.* 1991:106).
- Calcareous ash.* Laminated rock (e.g. Stonehenge Stone 40c). North Pembrokeshire (Thorpe *et al.* 1991:106).
- Sandstone 1.* Micaceous (e.g. Stonehenge Stone 42c). North Pembrokeshire (Thorpe *et al.* 1991:106).
- Sandstone 2.* Low-grade metasediments (e.g. four pieces from Aurbrey Holes 1 and 5, Stonehenge, and the Stonehenge Cursus). Pembrokeshire ? Coshaston Group (Ixer & Turner 2006:4–5).

Many of these stones were treated in the same way as the dolerites and spotted dolerites at Stonehenge. They stood as pillarstones, in later stages at least within the Bluestone Circle that lay between the Sarsen Circle and the Sarsen Trilithons. Like the dolerites they were broken

up, sometimes for the manufacture of tools, and taken away from the sites from the late third millennium BC onwards (Pitts 1982:124; Cleal *et al.* 1995:375–90). Deliberate placement of Bluestone fragments in graves is recorded with the Beaker-age burial in the ditch at Stonehenge (Evans 1983) and at nearby Amesbury 4 (Englehart 1932) and Amesbury 51 (Ashbee 1978), while unstratified pieces have been found at Winterbourne Stoke 28 (Cunnington 1929:226), Winterbourne Stoke 29 (Cunnington 1884:143), and Wilsford 35–36e (Colt Hoare 1812:206). Later use of these non-dolerite Preseli stones appears to be rare in the archaeological literature, but a reported instance of slate from the Preseli Hills used in the construction of the Roman Quay at Usk (Boon 1978:11) betokens trading in stone, probably roofing material, from sources in south-west Wales during the early first millennium AD. Certainly slate quarrying was a major activity in later times and by the 19th century was the single largest industry in the Preseli Hills, leaving a lasting impression on the landscape (Driver 2007:fig 178).

The Altar Stone in the centre of Stonehenge is a kind of Old Red Sandstone, long considered to derive from the Cosheston Beds exposed near Milford Haven in south-west Wales (e.g. Thomas 1923:244–5). However, a recent review of available samples from the Altar Stone by Rob Ixer and Peter Turner (2006) has shown that its fine- to medium-grained calcareous matrix is quite unlike any of the other sandstones known from Stonehenge and best matches samples from the Senni Beds which outcrop across south Wales from Kidwelly in the west to the Marches in the east; no exact source has yet been identified.

Investigations around Carn Menyn have revealed over a dozen quarries (Fig. 4) seemingly connected with the extraction of a light coloured meta-mudstone (Darvill *et al.* 2006: 100–5). Hammerstones have been found in close spatial association with some quarries, and there are extensive flaking floors of the same material. The technology looks prehistoric, but no recognizable artefacts have yet been found and the products from these workings remain unknown. Again, there is scope for further analysis and research here, starting with the handful of axes catalogued on the Implement Petrology Groups records as meta-mudstones.



Fig. 4.
Carn Menyn,
Pembrokeshire.
Extraction pits for
meta-mudstone on the
east end of Carn Menyn
ridge. Scale totals 1m.

[Photograph by
Timothy Darvill:
SPACES]

Discussion

South-west Wales contains more than its fair share of exploited stone. However, the tally of materials used during prehistory represents only a fraction of what was available, and more kinds of stone were ignored than were ever brought into the realm of the social. In a very real sense it must have been the perceived qualities of particular kinds of stone that attracted attention and prompted their use for monument building and in the production of implements. Materials and matter had meanings; stones were selected and shaped. When considering the creation of objects, and works of art in particular, the philosopher Martin Heidegger (1971:28) asked *'where does the matter-form structure have its origins – in the thingly character of the thing or in the workly character of the art work?'* A similar question can be asked of our archaeological materials and their use in prehistoric times, but here the trick is to step outside Western ways of thinking and allow a critical view of familiar categories and the polarised relationship between animate and inanimate (Reynolds 2009).

Colour and texture may have been important determinants of meaning. As Andrew Jones has shown, the selection of particular colours seems to have been important in the architecture of Neolithic tombs on Arran (1999), and the same is true for stone circles at Clava (Bradley 2000a: 216–7). The popularity of pale grey-green axes from Langdale (Group VI) may owe something to their superficial similarity with jadeite axes from Alpine Europe, and some of the light-coloured Welsh material may have been

selected for similar reasons. Spotted rock also seems to have been popular, not only in the spotted dolerites from Preseli (Fig. 5A) but also the porphyritic andesite implements from Ireland that can be traced to a source on Lambay Island near Dublin (Cooney & Mandal 1998:77–8; Cooney 1993; 2002; Fig. 5B), and the spotted dolerite used for making axes on Sark in the Channel Islands (B Cunliffe pers. comm.). All contain large white phenocrysts of quartz and/or feldspar, spots that following deep-rooted traditions along Europe's Atlantic coast could be considered embodiments of the soul (Darvill 2002) or indicators of life-forces within the stone (Reynolds 2009).

Biography, embedded stories, meanings, and the perceived power of particular stones may also be important, and nowhere is it better illustrated than with reference to rocks from south-west Wales used at Stonehenge and around about. These show seamless exploitation for monument building and artefact production. Many were reused several times over, and their power extends beyond prehistory through into modern times. Culturally, there is reason to see Stonehenge as being towards the eastern end of a territory extending westwards as far as Pembrokeshire. Certainly there are similarities in pottery styles across such a region from the early fourth millennium BC onwards (cf. the Coneybury Anomaly (Richards 1990:40–61) and Clegyr Boia (Williams 1952)), and at least some evidence for travel across the region by people and animals (Evans *et al.* 2006). As I have argued elsewhere, it was the placement of exotic and powerful stones at Stonehenge that gave the site part of its special interest, and widespread renown, that lifted it out of the ordinary at a time when the conspicuous consumption of energy and social wealth was at its prehistoric peak (Darvill 2006:119; 2007; Bradley 1998:101–115). A similar process, what Timothy Insoll has called 'shrine franchising', can be seen elsewhere in the world and at other times (Insoll 2006). Whether the Bluestones arrived early in the third millennium BC to occupy the Aubrey Holes just inside a newly constructed formative henge as Mike Parker Pearson has suggested (Parker Pearson *et al.* 2009:31–33), or during the mid third millennium BC to take up their positions in the Q and R holes as conventional wisdom dictates (Atkinson 1979:72–7; Cleal *et al.* 1995:169–88; Darvill 2006:120), or a combination of the two involving several phases of transportation, it is certainly the case that they were re-used in all later remodellings of the site and seem to have attracted particular attention during the later

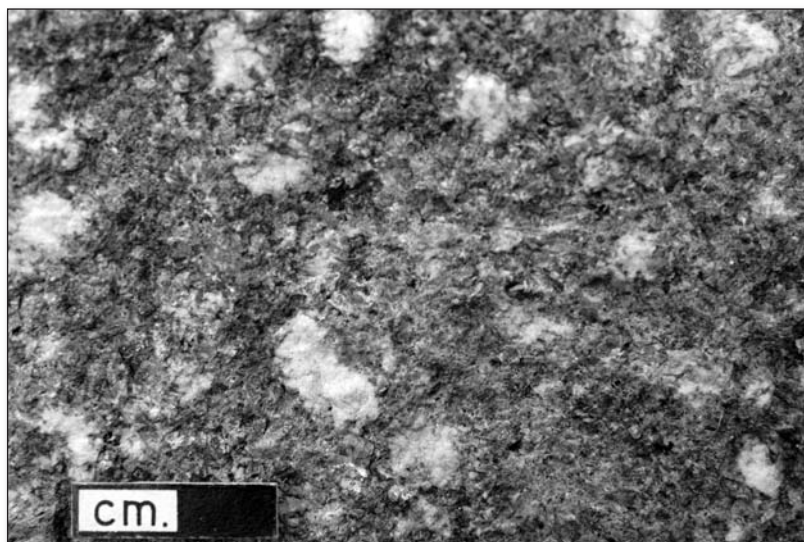


Fig. 5.
Spotted stone.
A:
Spotted Dolerite (Group
XIII) from Carn Menyn,
Pembrokeshire;
B:
porphyritic andesite from
Lambay Island, Dublin,
Ireland.
Scales each total 2cm.

[Photographs by
Timothy Darvill:
SPACES]



third millennium BC and beyond. While relatively few of the Sarsen components of Stonehenge are missing (5 uprights from the outer circle and 22 lintels), more than one third of the Bluestones are completely missing and another third are heavily denuded through later robbing (Ashbee 1998). As already noted, some of the broken-up Bluestones were used for the manufacture of axes and other kinds of implement, while fragments were placed in graves and carried off for use elsewhere with a new lease of life.

Following Mike Parker Pearson's idea that the stones symbolically represent the ancestors, memorials to the dead in a land of the dead (Parker Pearson & Ramilisonina 1998), such destruction could be seen as the deliberate slighting of ancestral ties to the past. But there are other aspects of the stones that suggest a quite different explanation and these revolve around the site as a place for living people wherein the power of the place derives from a sense that the stone is alive.

In post-medieval and modern times the Stonehenge Bluestones in particular were widely considered to have healing powers, a tradition first recorded in documentary form by Geoffrey of Monmouth writing in the 12th century AD (Monmouth 1136 / 1966:196; Piggott

1941; Grinsell 1975). Two aspects of his account – the source of the stones in the west of Britain and the need to arrange them at Stonehenge as they were at their source – find support from modern scientific studies (Thomas 1923; Bradley 2000b:92–6; Darvill 2006:fig 50; 2007), so why not accept the idea that the stones were attributed healing powers as a working hypothesis? Health and well-being is a fundamental human concern and in ancient times meant caring for the soul as well as the body in a malfeasant world. When added to the importance of fecundity and successful reproduction, maintaining good health in this wide sense is possibly the most powerful single driver of human action.

Axes have long been symbolically associated with maintaining good health (Ross 1967:185) and have been recognized in miniature forms, sometimes perforated and variously interpreted as talismans, amulets, and lucky charms, across many parts of prehistoric Europe (Skeates 1995: 281–3). Sometimes axes are associated with powerful deities, most notably the Scandinavian Thor whose axe-hammer / battle-axe brought life as well as a death (Davidson 1988: 46) in a way that perhaps finds parallel in the British Neolithic since forensic analysis has revealed the extent of trauma caused by axes on the skulls of people interred within long barrows (Smith & Brickley 2009:102–11). In south-

western Britain, divine couples are regularly represented in Romano-Celtic contexts, amongst them a stone relief from Gloucester showing Mercury with his *caduceus* and cockerel alongside a local version of the Gaulish goddess Rosmerta holding a *patera* in her right hand over a tub of water and a double-headed axe in her left hand; both are attributes that Ann Ross considers represent a healing cult (Ross 1967:210). At Stonehenge the spotted dolerite pillars of the Bluestone Horseshoe in the centre of the site have been shaped to resemble axes (Fig. 6A), pieces of Bluestone were used in the production of axes that later circulated around central southern Britain, skeuomorphic axes in soft local chalk were deposited on the site and at Woodhenge, imported stone axes of Group Ia, and III from Cornwall and Group XVIII from Northumberland are present and Stonehenge, and carvings of axes were added to selected sarsen pillars forming the Trilithons (Fig. 6B) and Sarsen Circle either side of the Bluestones (Darvill 2006:130). A single central idea based on the potency of the axe is perhaps here being expressed through a diverse materiality. In south-west Wales healing springs and sacred wells are numerous within and around the Preseli Hills (Jones 1992). Many are connected with the treatment of particular ailments, and collectively link rock and water: life and the

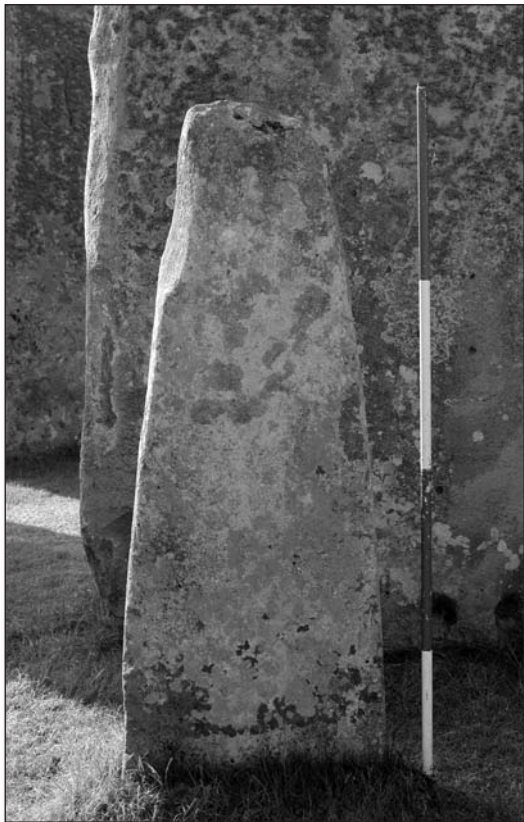


Fig. 6.
Stonehenge, Wiltshire.

A:

Axe-shaped stone,
Stone 63, in the
inner horseshoe.
Scale totals 2m.

B:

Axe-carvings and other
rock-art and graffiti
on the inner face of
Sarsen Stone 53.

[Photographs by
Timothy Darvill:
SPACES]



landscape. Water was also important at Stonehenge as the route to Stonehenge Bottom and the River Avon was monumentally formalized through the construction the Avenue, the first section of which is aligned on the solstitial axis running through the stone structures at Stonehenge itself. Cup-marks are associated with some of the sacred wells and springs in south-west Wales (Darvill *et al.* 2004:106–8; Anon 2008), while the so-called chalk-cups from Stonehenge (Cleal *et al.* 1995:406 item 11) and around about (Thomas 1952) are essentially cup-marks in small portable blocks of local rock and may have served a similar purpose. As Miranda Green (1986:164) has noted, there is a close association between the sun, water, and healing in later prehistoric symbolic systems right across Europe.

Looked at in such a broad perspective, it was both the ‘stonely character’ of the stone from south-west Wales and the ‘workly character’ of how and where it was used that was important to prehistoric people. Whether structurally embedded in monuments or carried around as implements and talismans, the carefully selected stones brought-forth, opened-up, and fixed into place self-establishing patterns of experience and engagement that gave life and added meaning and purpose to the human condition.

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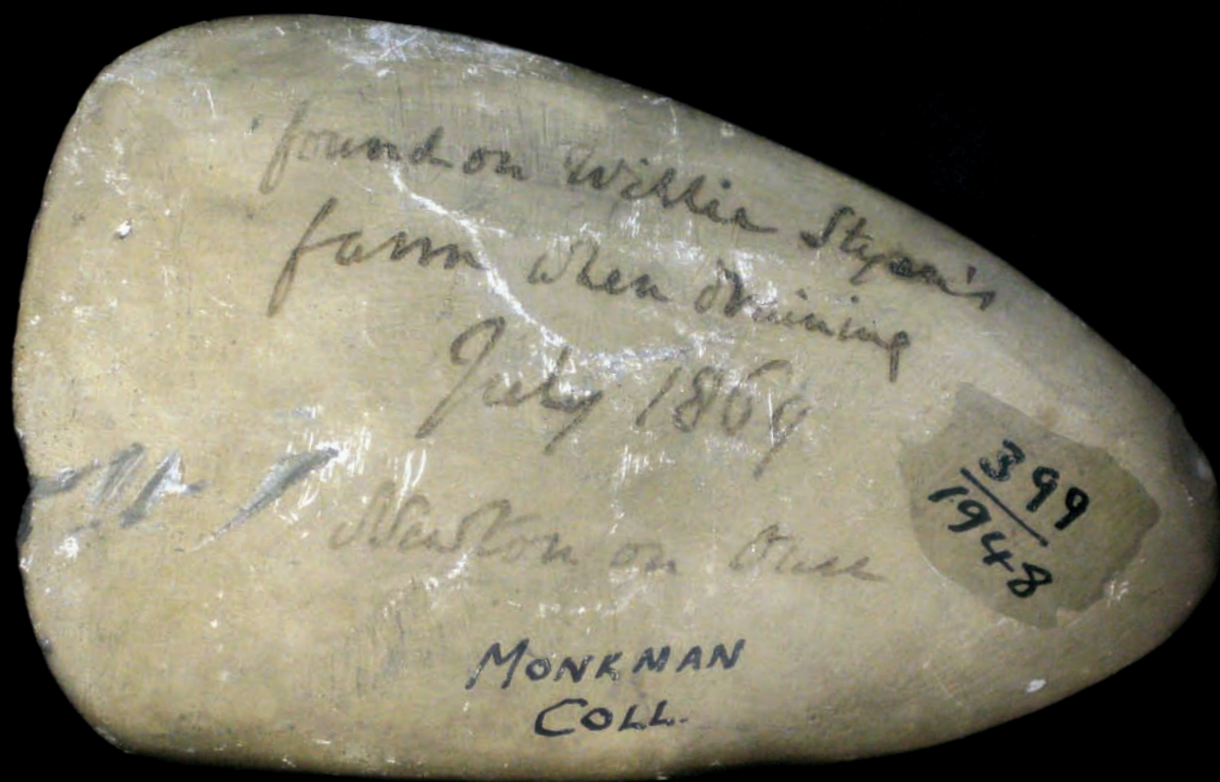
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■ ■ ■ From the later eighteenth century, agricultural improvement fed the appetites of antiquarian collectors. Ploughing and drainage brought large tracts into intensive cultivation and this, in turn, brought a rich crop of artefacts to the surface. Many of the larger landowners in Britain, those who were quick to enclose and improve, had kept stone and flint blades in their *Cabinets of Curiosities* for some time. By the middle of the nineteenth century however, collecting was a more widespread practice, one of several that animated and defined a burgeoning middle class. By then, it was land brought late to improvement which provided the greatest harvest; upland country or ground that required drainage on a more or less industrial scale. So it was in much of Northern and Eastern Yorkshire, where late improvement stimulated a vigorous trade in stone tools. Fuelled by broader debates about social evolution and coloured by ethnographic parallels, collecting was an expression of learning and sophistication. It provided the raw material for narratives about prehistory, accounts which people like Canon Greenwell, John Mortimer or Charles Monkman published in the pages of the *Malton Messenger* or the *Yorkshire Archaeological Journal*. But it was also something else; an instrument of competition which defined the minutiae of individual positions within a local social hierarchy. In that context, the size, quality and range of personal collections was something that mattered. And because it mattered, there was money to be made. Farm labourers were offered cash or tobacco for artefacts (or *Mortimers* as they were sometimes known) found in the fields, while itinerant dealers supplied more established collectors. There was even money to be made in replicas. It is no small irony that a keen interest in typology was sometimes fuelled as much by a desire to avoid being duped by forgeries as it was by interest in the character and chronology of ancient cultures. ■



●●● *I'd gone into the yard to check it was OK to drive up to the top, what with the stock and all. M was by the back door putting an edge on the garden shears and we stopped for a natter. It was a while before I realised that his whetstone was a broken axe, pitted on one face and smoothed on the other where the metal had left a bit of a shine. He said it had been kicking around for years, had no idea how he'd ended up with it. But it was just the thing for sharpening. ●*

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Production and diffusion of axes in the Seine valley

Abstract

This paper presents the first results of research into the production of flint and stone axes in the Seine valley west of Paris. The data originating from the production sites (mines and axe factories) allow us to define the reduction sequence of axe manufacturing for each raw material (Bartonian flint, cretaceous flint, quartz sandstone). The recording of flaked and polished axes preserved in surface collections and the mapping of the findspots also allows the study of the diffusion of these implements according to different production stages. The emphasizing of exogenous products enables the reconstitution of large-scale circulation networks of axe blades and demonstrates the role of the River Seine as a trade route.

Study area and material

The study area comprises one part of the Lower Seine basin between Paris and Le Havre (Fig. 1), and the analysis of axe distributions is confined to this area. Field research into the mines and production sites of flint axes concerns a smaller area of 50 km length and 50 km width, immediately west of Paris, i.e. the northern part of the Yvelines department as well as the central and western part of the Val d'Oise department. In the centre of this area, the Seine River meanders in large loops and drains numerous tributaries from the north and the south (Fig. 2).

The study area is situated at the transition of the Tertiary and the Secondary Basin which corresponds approximately to the actual limit between the Île-de-France and the Normandy. The carving out of the valleys during the early Quaternary has determined the actual landforms. The different plateaus are formed by terraced structural platforms which correspond to the limestone outcrops. Platforms of coarse limestone (Lutetian), of Saint Ouen limestone (Bartonian) and of Beauce limestone (Stampian) are encountered in the Vexin and Yvelines regions. Buttes are essentially composed by Fontainebleau sands. They are aligned to the tectonic axes in northwest/southeast direction. This is where sandstones and more particularly quartz sandstones can be found. On top, these

formations contain quartz sandstone slabs formed by groundwater flow at the edge of the valleys. Other, softer sandstones, sometimes erratics, have been used as polishing stones.

Numerous flint seams are embedded in the Senonian chalk (Santonian and Campanian) on the slopes of the Seine, Vesgre and Mauldre rivers. South of the Seine River, these chalk deposits are also represented on the valley floors of the Vaucouleurs and Ru de Senneville streams. To the north, the outcrops can be found along the Vigny anticline. Saint Ouen limestone (Marinesian) outcrops mainly at the edges of the plateaus. It can yield calcareous silifications of outstanding quality as they are known from other sectors of the Paris Basin (Aisne and Marne valleys). This silexite, called 'tertiary flint' in the following text, occurs in the form of slabs with varying dimensions and thickness. This material is fine-grained, often of outstanding quality and of light beige to dark brown colour, occasionally spotted or veined. Some slabs are badly silicified and not suitable for knapping. Silt deposits are particularly well-preserved on top of the plateaus. They form an almost continuous cover with thicknesses from 3 to 6 metres and were selected as dwelling places by the first farmers as is attested by a very large number of registered sites.

The first Neolithic sites in the region are dated to the Villeneuve-Saint-Germain Culture

Fig. 1.

Study area and known mines in Northern France.

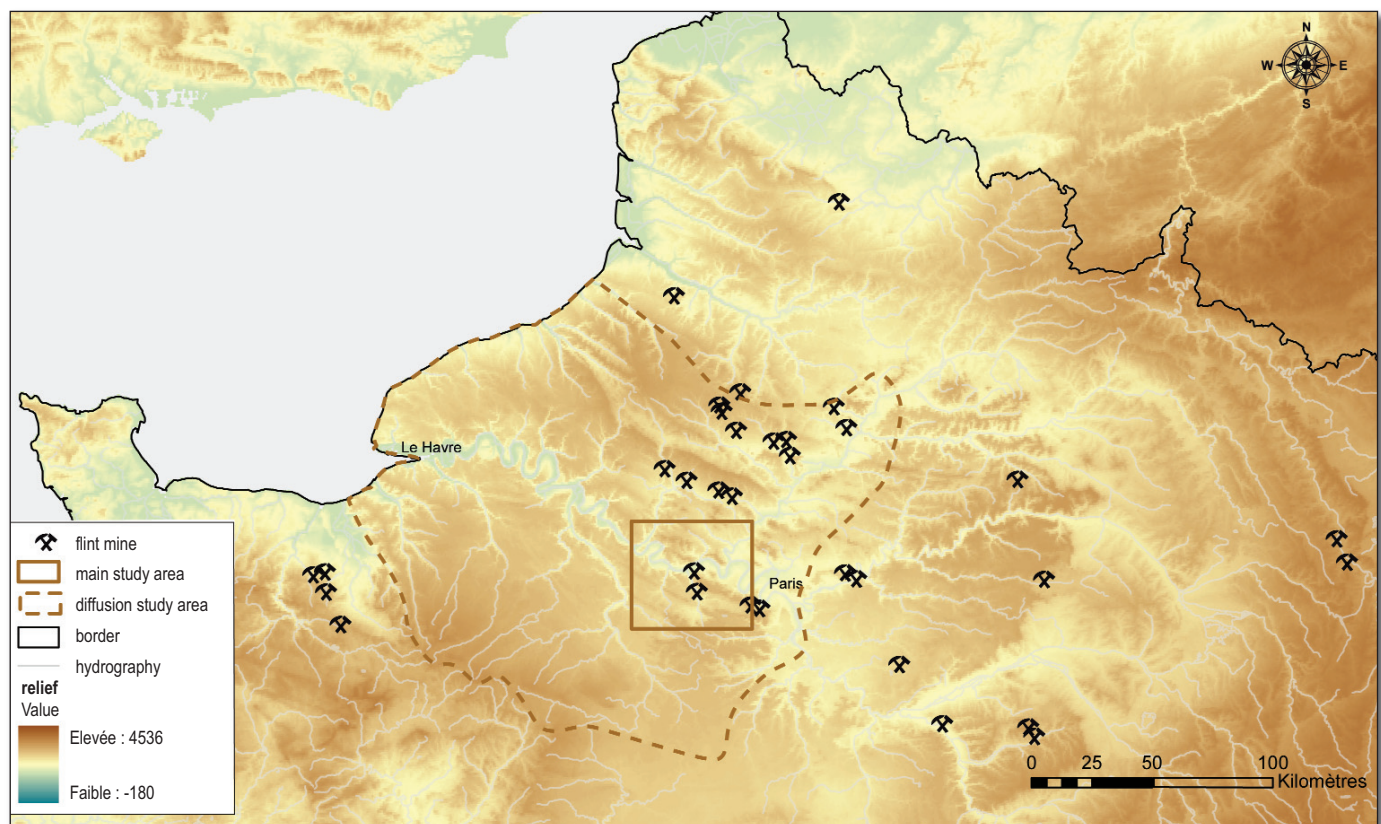
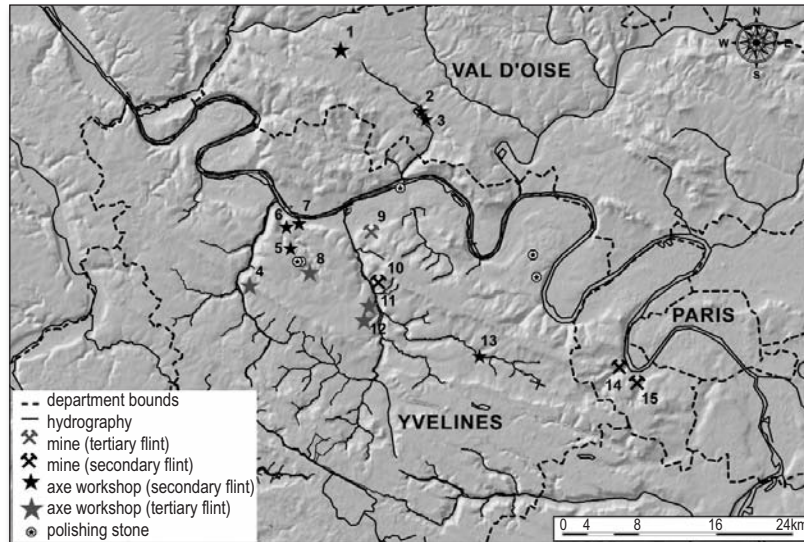


Fig. 2.

Extraction and production sites of axes in the western Paris region (Yvelines, Val d'Oise).
DAO C. Riquier/F. Giligny.

- 1:
Banthelu/Charmont;
- 2:
Longuesse (Les Baudes);
- 3:
Longuesse (Station d'épuration);
- 4:
Rosay (La Sablière);
- 5:
Guerville
(Les Dix Arpents);
- 6:
Guerville
(Les Fosses Rouges);
- 7:
Guerville (Saint-Germain-de-Secval);
- 8:
Jumeauville (La Croix de Jumeauville);
- 9:
Flins-sur-Seine/
Aubergenville;
- 10:
Maule (Pousse-Motte);
- 11:
Montainville;
- 12:
Beynes (Bois de Carcassonne 2);
- 13:
Villepreux (station d'épuration);
- 14:
Sèvres (Brimborian);
- 15:
Meudon (Bas Meudon).



orVSG (5000–4700 BC) which follows the latest phase of the Linear Pottery or “Rubané du Bassin Parisien”. Dense occupation clusters assigned to this culture are known in the Seine valley and on the silt or loess plateaus (Bostyn *et al.* 2003; Marcigny, Ghesquière *et al.* 2007). One isolated Linear Pottery site is known further west in the Caen plain and it is possible that yet unknown settlements dated to the Linear Pottery Culture may have existed along the Seine River between Paris and Rouen.

Flint mines in the Paris Basin are exploited from the Middle Neolithic period onwards (4700–3400 BC), broadly simultaneous with the emergence of enclosures and monumental burials during the Cerny, Rössen and Post-Rössen, Chasséen or Michelsberg cultures. During the ensuing Late Neolithic (Seine-Oise-Marne: 3400–2800 BC) and the subsequent Final Neolithic (Gord and Bell Beaker: 2800–2200 BC), numerous collective burials were established and then reused. Single burials reappear with the Bell Beaker Culture.

Effectively absent from the Linear Pottery culture, flint axes first appear during the Villeneuve-Saint-Germain culture, their frequency increasing on Middle, Late and Final Neolithic sites. During these periods, flint axes are also encountered in collective burials. Implements produced from metamorphic and exogenous igneous rocks are present but more rarely on Linear Pottery sites and more largely on Middle and Final Neolithic sites.

Over the last two decades, a series of excavations of Neolithic sites as well as research projects (of which several are still ongoing) have been conducted in this region. At the confluence of the Seine and Eure rivers, settlement and burial sites spanning the entire Neolithic have been excavated and partially published.

(Billard *et al.* 1991, 1995; Bostyn *et al.* 2003; Giligny *et al.* 2005). Several research programs are concerned with the Seine valley. Since 1998, a research project on the Neolithic of the Western Paris Basin has sought to study settlement patterns in both the Yvelines and Val d'Oise departments in relation to exploited raw material sources (Giligny *et al.* 1998, 2006). Another research program aims at investigating the archaeology of the Paris Basin from the Palaeolithic to the Middle Ages and focuses on different aspects of the spatial organization pattern and the relationships between human groups through time and space in this large area (Brun & Karlin 2005).

The research reported here has been undertaken against an important background, taking the form of a reference compilation of academic work and collection inventories which has been constituted since 2001. This concerns mainly the Yvelines, Eure and Seine-Maritime departments and to a lesser extent the neighbouring departments. Only a small number of excavations have been undertaken and archaeological knowledge is essentially based on surface discoveries preserved locally in museum or private collections. These collections are very extensive. Work so far has detailed evidence for flint axe production (Lo Carmine 2000, 2002; Couderc 2005; Lethrosne 2006), the character of hard rock and sandstone implements (Le Maux 2006, 2007), and the inclusion of material in burial contexts (Barniers 2004; Yam 2005).

These data have been registered in a database providing one registration file per piece and one per locality. Without exception, the pieces geographically attributed to a commune have been registered. For pieces with unknown provenience, only those belonging to collections or presenting features of typological or

material interest have been taken into account. In the current state of research, the flint axe inventory contains pieces originating from seven departments (Yvelines, Val d'Oise, Eure, Seine-Maritime, Eure-et-Loir, Oise, Hauts-de-Seine). 941 complete pieces, of which 427 come from the Flins-sur-Seine mine, and many fragments elevate the total to 1507. A further assemblage of 319 complete and fragmentary pieces produced from hard rock material originate from the two main departments (Yvelines and Val d'Oise) while another 1121 stem from the seven departments cited above.

Our work has progressed through several stages. The first saw the detailed description of evidence for axe blade production, with attention paid to any distinctions between items that appear exogenous or of local origin. Several production sites (mines and axe factories) have also been prospected. The most important site, the Flins-sur-Seine mine, has been explored by aerial survey as well as systematic surface and geophysical prospection (Bostyn *et al.* 2008). Based on the material from collections, the character of the reduction sequences for flint axes have been described. An evaluation of the exogenous hard rocks has also been made as part of the JADE program concerning alpine productions. The purpose of this research into exogenous rocks was to identify large-scale circulation networks from nearby or distant areas (Normandy, Armorican Massif, Alps). The distribution mapping for each material was undertaken so that we could identify the diffusion of products according to each stage of the reduction sequence and to evaluate the contribution of each raw material within the regional assemblages.

Tertiary flint axe production

Our picture of tertiary flint axe production draws heavily on evidence from the Flins-sur-Seine mine and from knapping workshops (Jumeauville, Montainville, Beynes: *Table 1*) as well as from surface discoveries and other site excavations.

The Flins-sur-Seine mine dominates the River Seine and is situated on the right bank of one of its tributaries, the Mauldre, on a plateau at 125m level and on a slight slope oriented southeast/northwest. Known since the 1930's, it has been the subject of many surface (field-walking) surveys (e.g. Sylvestre de Sacy & Baudouin 1926, 1927). Various methods have been utilized to conduct research on this site without excavation. A campaign of aerial photography was conducted in 1999 by the "Service départemental d'Archéologie" of the Yvelines, which revealed the presence of extraction shafts. Subsequent geophysical prospection program offered confirmation, identifying areas of lower resistivity probably corresponding to the tops of shafts (Aubry *et al.* 2003). This work went hand in hand with surface survey which allowed detailed collection and the identification of concentrations of knapping waste (Giligny *et al.* 2006).

These various forms of survey were accompanied by the experimental digging of an extraction shaft in 2003, which provided important data on the material conditions and consequences of this kind of procurement (Bostyn *et al.* 2009). The combination of these different methods shows a close and distinctive matching between the features detected by electrical prospection, by aerial photography and the greatest concentrations of knapping waste on the ground.

Table 1.

Sites and evidence for production sites of axes made from secondary and tertiary flint in the Yvelines and Val d'Oise departments.

MADVO:
Musée Archéologique
Départemental du
Val d'Oise;
SDAVO:
Service Archéologique
Départemental du
Val d'Oise;
SADY:
Service Archéologique
Départemental
des Yvelines;
ASEP:
Association pour la
Sauvegarde et l'Etude
du Patrimoine de
Flins-sur-Seine;
CRARM:
Centre de Recherches
Archéologiques de la
Région Mantoise.

Commune	Lieu-dit	Source	Conservation place	Material
Banthelu	Fossé Rouge et indéterminés	field survey J.-M. Lardy & R. Martinez	MADVO	campanian flint
Charmont	Côte Blanche	field survey	MADVO & SDAVO	campanian flint
Longuesse	Station d'épuration	field survey J.-M. Lardy	MADVO	campanian flint
Longuesse	Les Baudes	field survey J.-M. Lardy	MADVO	campanian flint
Maule	Pousse-Motte	excavation 1968–1972 (Simon 1986)	?	campanian flint
Guerville	Saint Germain de Secval	field survey CRARM 1991 & 1994	CRARM	campanian flint
Guerville	Les Dix Arpents	field survey J.-P. Peulvast	Private coll.	campanian flint
Guerville	les Fosses Rouges	field survey CRARM 1981–1983	CRARM	campanian flint
Villepreux	Station d'épuration	excavation 1999 (Samzun 1999)	SADY	campanian flint
Beynes	Bois de Carcassonne 2	field survey P. Labreuil, 1999–2005	SADY	Bartonian flint
Flins-sur-Seine/ Aubergenville	Le Clos, La Fauçillière etc.	Numerous field survey 1926–2008	CRARM, SADY, MPIF, ASEP	Bartonian flint
Jumeauville	La Croix de Jumeauville	field survey CRARM	CRARM	Bartonian flint
Montainville	La Fauconnerie	field survey A. Guérin	Private coll.	Bartonian flint
Montainville	Bloche ; Le Noyer Michel	field survey A. Guérin	Private coll.	Bartonian flint
Rosay	La Sablière	field survey CRARM	CRARM	Bartonian flint



Table 2.
Occurrences of the
analysed products
originating from the
Flins-sur-Seine mine.

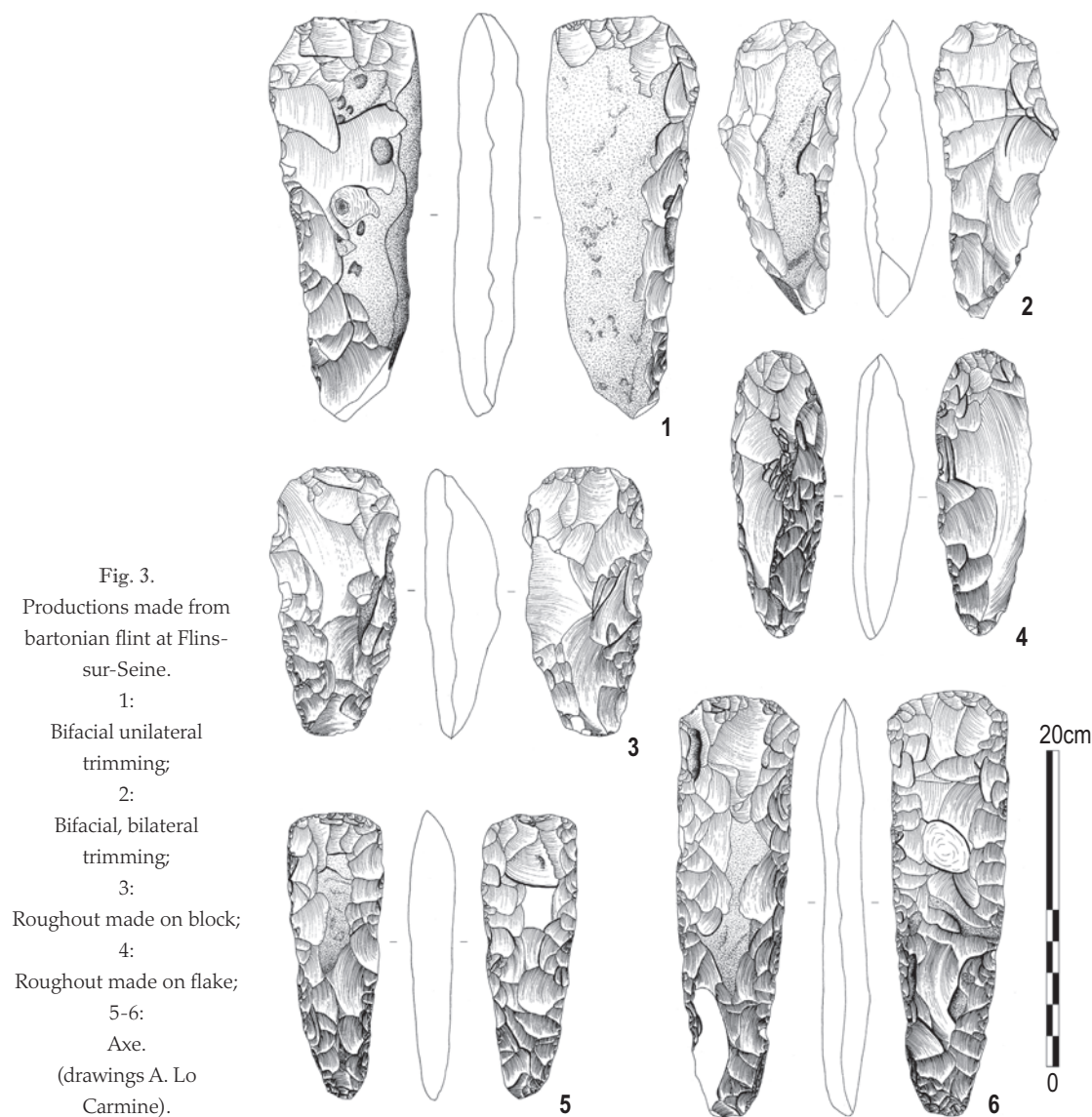
	Number	%
Unifacial trimming	10	2,3%
Bifacial unilateral trimming	40	9,3%
Uni/bifacial trimming	23	5,4%
Bifacial bilateral trimming	142	33,2%
Roughout	144	33,6%
Axe	69	16,1%
Total	428	

Insights on the character of reduction sequences at Flins-sur-Seine are provided by the study of 428 complete pieces originating from six collections (Table 2). The analysis of debris and tools shows that knapping was commonly directed towards the manufacturing of axes. There appears to have been variability in the pattern of selecting or preparing blanks, which took the form of either untreated slabs or large flakes. These choices were taken up in roughly equal measure, though a small number

of additional pieces were manufactured on frost-fractured flakes (16 i.e. 3.7%). Beyond these different starting points, reduction sequences vary only a little. We have distinguished the following products originating from the manufacturing stages in the order of the reduction sequence:

Unifacial and unilateral trimming,
Bifacial and unilateral trimming (Fig. 3, n°1),
Bifacial and unifacial trimming,
Bifacial and bilateral trimming (Fig. 3, n°2),
Roughout (Fig. 3, n°3–4) and
Flaked axe (Fig. 3, n°5–6).

The last three stages are the ones represented most frequently, accounting for 82% of the collection. Polished pieces are virtually absent on the mine site. Strong similarities can be observed between the reduction sequences displayed at Flins-sur-Seine and at the Jablines



mines insofar as similar raw material is utilized (Bostyn & Lanchon 1992).

Analysis suggests that the discarding of pieces was most commonly linked to either raw material quality or to questions of know-how or *Savoir-faire*. The quality of the raw material is rather mediocre. In fact, one third of the pieces contain one or more internal cavities and another third show intrusive cortex. 64 pieces present insufficient silification and 59 pieces show diachlases. 99 pieces (23.1%) combine two defects and 22 pieces (5%) three defects.

That said, raw material quality did not constitute an insurmountable problem for the flint knappers, as the breakage of pieces was rarely caused by defects in the flint (5 cases). As a consequence, the hypothesis of insufficient know-how has been tested. In order to evaluate the levels of skill, we have registered the variables thought to provide a basis for comparing knappers: hinged flakes, plunging, over-pronounced concavity, extensive marginal flaking. The most common knapping error is the hinging of shaping flakes which can be observed at proportions of nearly 70% for each stage of the reduction sequence independent of the blank type. The percentage of pieces with concavities is rather low and constantly below 50%. This kind of problem is less marked for pieces made from flakes and for flaked axes. The number of pieces presenting plunged blows is always lower than 20%. Finally, extensive marginal flaking problems can be observed in 40–60% of the pieces independent of the stage within the reduction sequence. The dimensions of the products recovered from the mine correspond to lengths between 8 and 14 cm. Larger pieces exist (between 15 and 25 cm) but remain scarce. Not surprisingly, pieces belonging to the primary reduction stages are larger, especially when the blanks are made from tabular flint.

In sum, the evidence from the Flins-sur-Seine mine demonstrates the use of often mediocre raw material quality for middle-sized axes, and the working of that material in ways that did not always require significant levels of skill. These observations match those made by A. Augereau (1995) concerning the Villemaur-sur-Vanne (Aube) mine, although the raw materials are quite different.

The analysis of material from Flins-Sur-Seine included pieces that were evidently used in activities accomplished in the mine itself. They were considered alongside other production waste because they were not carried out of the mine and were therefore clearly not perceived as being of use beyond that setting. In order to better understand the kinds of criteria that

influenced those decisions, we undertook a second stage of analysis. This was aimed at a direct comparison between these products and those recovered away from mine or factory contexts.

The inventory of collections has enabled the study of numerous blades found beyond the limits of the Flins-sur-Seine mine. These include 70 polished axes, 21 flaked axes and 52 complete roughouts. The majority of these pieces are characterised by very regular edges and cross-sections as well as by larger dimensions (Fig. 4, n°1–3). In contrast to the material from Flins-sur-Seine, edge pecking is present on some of these pieces. This technical step preceding polishing can be discerned mainly on polished axes even if some flaked axes also display pecked edges. This action tends to reduce the margins in order to obtain a biconvex cross-section with straight sides. A first experimental test has shown the efficiency of edge pecking with a simple, rather thin flake (Giligny *et al.* 2005:69–87). Consequently, these tools present pecked and notched edges resulting from hard hammer percussion. Identical tools have been recovered from other sites like Jumeauville and have been observed in mine context at Jablines [le Haut Château] (Bostyn & Lanchon 1992: fig. 209). Pecking is also a reshaping method in particular for the recycling or hafting of imple-

Fig. 4.
Large polished
and flaked axes.

- 1:
Guerville;
- 2:
Bonnières-sur-Seine;
- 3:
St-Germain-en-Laye;
- 4:
Marly-Rocquencourt;
- 5:
Broué;
- 2–3:
bartonian flint;
- 1, 4–5:
secondary flint.

(drawings
A. Lo Carmine.
1, 5: Musée de l'Hôtel
Dieu, Mantes-la Jolie;
2: Collection Peulvast;
3, 4: Musée de
l'Archéologie Nationale)

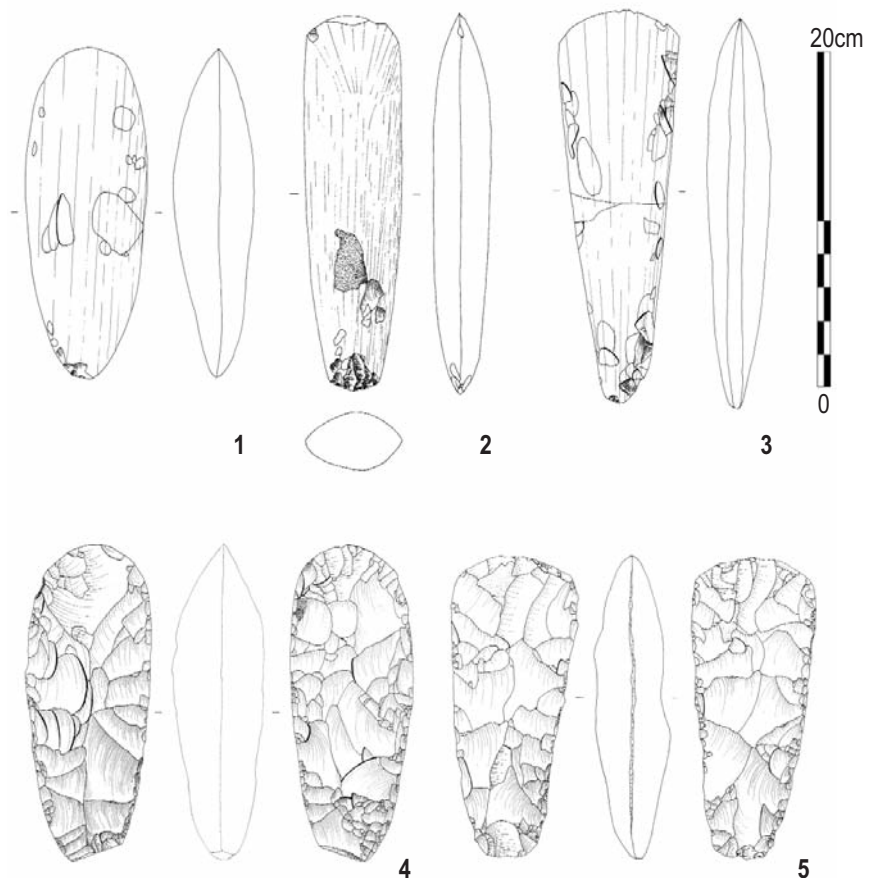


Fig. 5.
Bifacial trimming and roughouts made from secondary flint.
1:
Villepreux
(Station d'épuration);
2, 4:
Guerville (Saint-Germain-de-Secval);
3, 5:
Banthelu;
6:
Longuesse (Station d'épuration).
(drawings J. Couderc, collections du MADVO).

These first observations point out differences in quality between the products found on and at distance from the production sites. While length is a criterion that can be easily identified, the lack of certain stages of the reduction sequence, more particularly the finishing stages of the products (pecking, polishing), confirms the waste status of these products found in the mines themselves.

The production of axes from secondary flint

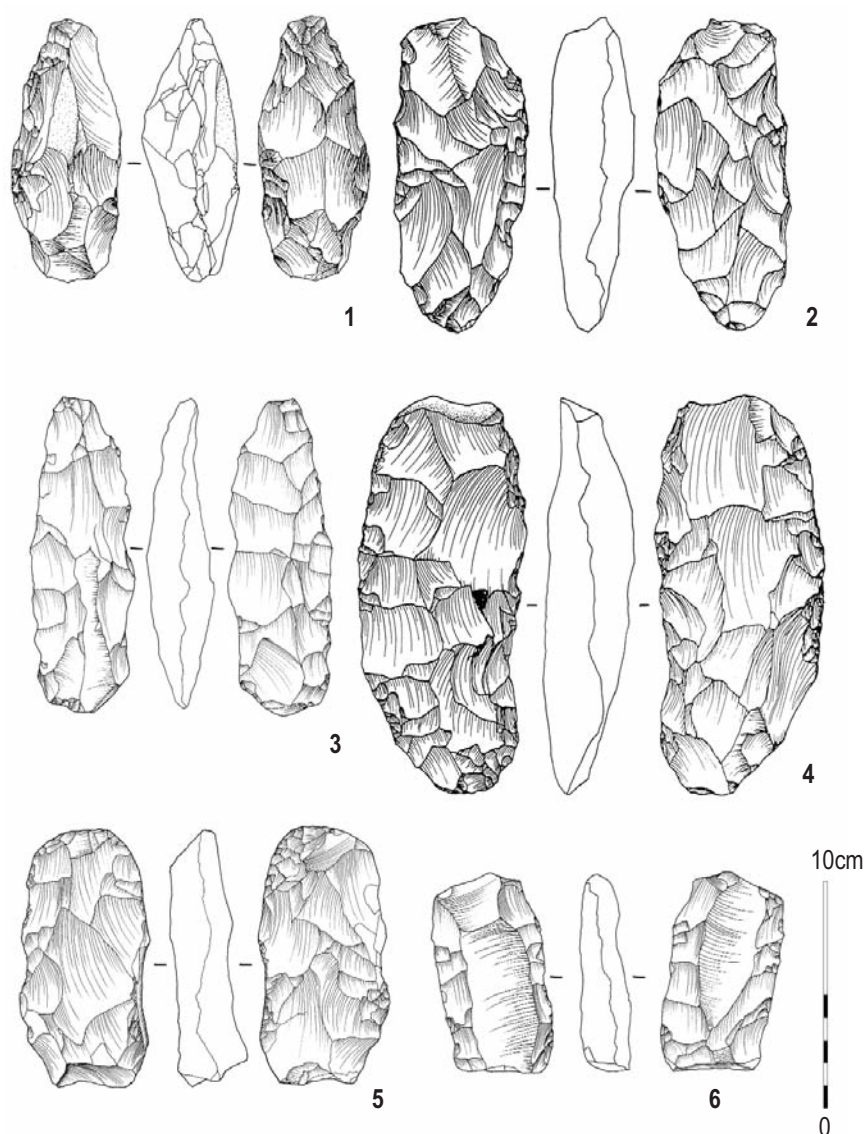
Production and extraction sites reflecting the exploitation of secondary flint are situated on slopes or in the valley floors. Two sites have been excavated: a mine at Maule « Pousse Motte » (Simon 1986) and an axe factory at Villepreux « Station d'épuration », (Couderc 2001; Samzun *et al.* 1999). Axe factories have been discovered by surveys at Guerville,

Longuesse, Banthelu and Charmont (Couderc 2003 and *Table 1*). Extraction was made by shafts at Maule, but the mining techniques (shafts or extraction on slope side) are as yet unknown for the other sites. The raw material is of mediocre quality with numerous frost-fractured blocks (48% at Maule and 40% at Villepreux). The recovered debitage waste and products are rough or tested blocks, worked nodules, roughouts, flakes and scars as well as several rare items originating from other forms of reduction (flake cores, arrowheads, tools).

Chronologies here are uncertain. Absolute dates or elements for relative dating have been obtained only from sites which have seen excavation, but even these are problematic. At Maule, the assemblage is assigned to the Final Neolithic, yet the two radiocarbon dates correspond to the Early and Middle Bronze Age (Gif 5007: 3460 ± 70 BP, Ly 2694: 3630 ± 130 BP: Simon 1986). At Villepreux, the finds comprise a series of final Neolithic potsherds as well as transverse arrowheads which are dated to the Late Neolithic (Seine-Oise-Marne). However, the three radiocarbon measurements do not match this assignment as one of them dates to the Early Bronze Age.

Places that saw axe manufacturing are identified by the presence of the three main stages of the operational sequence of bifacial products: worked nodules, roughouts and flaked axes (Fig. 5). With an assemblage of c.415 pieces, the site of Banthelu is the richest in this category, with roughouts comprising 54.4% and worked nodules 43.4% of the total respectively (*Table 3*). The site of Villepreux, the only one to have been excavated, contains a small number of roughouts (5 pieces) and even fewer finished or semi-finished products (e.g. only one flaked axe). Away from the axe 'factories', these proportions are reversed.

Secondary flint of Santonian-Campanian type is essentially represented by nodules with rather irregular shapes and sometimes by slabs. The blank morphology makes the first stages of shaping difficult. Nonetheless, a standard reduction sequence can be traced. A first stage of preliminary flaking of the nodular stone is realised in order to regularise the blank by removing all excess material. Flake blanks can then be obtained and transformed. During a second stage, the bifacial and bilateral adjustment of the edges is made, before the final regularisation of the roughout. As an original technological process, fluting realised by blade removals is observed on one or both surfaces in the longitudinal direction and aims to reduce the thickness of the pieces (Fig. 5, n°6). Axes



	Nodules & bifacial preparations	Roughouts	Non polished axes	Polished axes	Undetermined	Total
Villepreux ¹	23	5	1			29
Guerville ²	9	32		8		49
Banthelu ³	139	174				313
Longuesse ³	9	15				24
Charmont ⁴	26	78				104
workshops	206	314	1	8		529
other sites	12	91	29	231	9	372
Total	218	405	30	239	9	901

Table 3.
Occurrences of the analysed products made from secondary flint in the axe factories.

made on flakes are less numerous compared to those made of tabular flint blocks.

Here again, products appear to have been discarded for reasons linked either to the raw material quality or to problems of know-how. The raw material can be unsuitable for knapping and contains diachlases or geodes causing occasional irregular fractures. In other cases, manufacturing has evidently been undertaken in a rather awkward manner. Flaking angles are not respected, which causes knapping errors such as hinging and plunging. Traces of repeated percussion on the edges also show an obvious lack of know-how. A bad positioning of the piece and the application of far too much force in percussion are also responsible for frequent breakage.

The assemblage of complete polished axes produced from secondary flint contains 239 pieces originating almost exclusively from sites out of factories. Three quarters of polished axes have egg-shaped cross-sections (*Fig. 4, n°1*). The length of the products originating from these factories varies between 10 and 20 cm. The major part (22 pieces) possess lengths from 12.5–15 cm, while pieces from 15–17.5 cm are less frequent (11 pieces). Across the entire study area, semi-finished products (flaked axes) tend to have lengths of between 7 and 20 cm, with several pieces up to 34 cm. The majority of complete polished pieces tend to be 7–16 cm in length, with some pieces up to 26 cm.

Reshaped polished axes made from secondary flint occur in very high numbers. The majority show signs of having been reused for similar functions (axes, wedges or cutting tools). The working edge is often resharpened in order to create a new cutting edge. Butt and ridges are eventually reworked to readjust the blade for a new haft. Sometimes, the blade is entirely reflaked and only a few polished areas are preserved. Inevitably, the number of reflaked and then repolished blades can not be estimated as polishing has erased anterior traces.

There are even some cases where blades have taken on a different role entirely. There are

a number of roughouts and polished axes made from both secondary and tertiary flint, which show a very shiny gloss on the cutting edge. These pieces have not been used for woodwork (or not exclusively) but for hard-hammer percussion on soft and loose material like clay or silt, activities associated with the breaking up or working of soil (Beugnier 2000; Bostyn *et al.* 2003).

Production in other materials

The project has identified a number of blades made of flint or other stone from exogenous sources. About fifteen axes made from secondary bathonian flint have been characterised (Lethrosne 2006:fig. 7). This material very likely originates from Lower Normandy, notably from the factories and flint mines situated in the Caen-Argentan plain at the eastern fringes of the Armorican Massif. The Bretteville-le-Rabet (Calvados) mine, or that excavated recently at Ri (Orne) testify to the existence of extraction sites dedicated to this raw material (*Fig. 1*). Blades in this material are always complete or reflaked polished examples. They also tend to retain a significant area of cortex on the butt. According to J. Desloges, this characteristic, absent from the regional flint mines, is rather common for bathonian flint from Bretteville-le-Rabet. It corresponds to the configuration of flint blocks extracted from seams fissured in a transverse direction, which present cortex on either end (Desloges 1986, 1999). When the block is small, the requirement to produce blades of a reasonable size would make it likely that some cortex would be preserved on the butt. The collections also include a smaller number of axes made from flint that comes from yet more distant sources. These sources cannot always be identified, but in one case, it is likely that an axe blade made on Turonian flint originated in the Grand Pressigny region.

The working of other materials is also represented. A sedimentary rock, quartz sand-





Fig. 6.

- Axes made from quartz sandstone and exogenous hard rocks
- 1: La Bucaille (Eure), adze made from fibrolite. Musée d'Evreux;
 - 2: Aux environs de Rouen (Seine-Maritime). Axe made from metadolerite of type A. Muséum d'Histoire Naturelle de Rouen;
 - 3: Dreux (Eure-et-Loir). Adze made from quartz sandstone. Musée de Guiry-En-Vexin;
 - 4: Unknown origin, Musée de Bernay (Eure). Adze of material group eclogite-omphacite-jadeite.

stone, comprises siliceous cement containing more than 80% of quartz grains; it is also called 'arenite quartz' if this percentage exceeds 95% (Bishop *et al.* 2001:p.198). The embedding of the grains in addition to the siliceous cement provides this rock with quite developed hardness as well as strong homogeneity which present an important knapping suitability. This material is thought to originate from geological layers assigned to the Stampian which are present in the entire Paris Basin. It is thus a preferred material for the manufacturing of axes and adzes and could be procured locally or regionally.

These materials represent 10% of the regional polished axes (236 pieces) which generally occur as finished products, rarely as roughouts (Le Maux 2006). Knapping techniques, i.e. pecking and polishing, are combined for their manufacturing. The morphology of these products is dominated by egg-shaped forms with large oval sections (Fig. 6, n°3). In the current state of research, extraction sites for this raw material are ignored whilst the existence of production sites can be assumed. The form in which these products are diffused as

well as the distribution limits and the chronological and cultural impact of this phenomenon have yet to be adequately determined.

Additional raw materials represented in the collection include limestone and a number of exogenous 'hard rocks'. The latter are named following the term introduced by M. Ricq-de-Bouard (1987a and b) to describe rocks according to their physical qualities i.e. mechanical strength, hardness and toughness. We have distinguished 31 different types of rocks within an assemblage of 941 pieces, and while a few of the older attributions probably need checking, the majority of these 'hard rock' axes were clearly made from a few recurrent rock types: dolerite and metadolerite (Fig. 6, n°3) as well as pyroxenite (for more detail on mineralogical and petrological properties, see Le Maux 2007, 2010).

Circulation and diffusion

So far as the distribution of local flint products at a regional scale is concerned, the diffusion pattern varies according to each stage of the reduction sequence for both tertiary and secondary flint. The first fabrication stages are principally recovered from axe workshop areas, from the production sites or near neighbours (Fig. 7, n°1). Tertiary flint roughouts are widely distributed between Mauldre and Vaucouleurs (Fig. 7, n°2). They are also recovered in large numbers from the Vexin region. Although secondary flint shows a more scattered distribution, the first fabrication stages are concentrated near to axe factories (Fig. 7, n°2).

Tertiary flint flaked axes are less frequent and their diffusion is rather similar to that of the roughouts (Fig. 8, n°1). One roughout and one fragment of a flaked axe originate from the excavation at Louviers 'La Villette' (Giligny 2005). These pieces are not locally manufactured and consequently have been imported. Secondary flint flaked axes are however more frequent in the Vexin region compared to the area on the left bank of the River Seine (Fig. 8, n°2). They are more particularly concentrated along the Vigny anticline where the Campanian chalk outcrops and the factories are situated. Tertiary flint polished axes are still more widely distributed. They are also encountered out of the mapped area downstream along the Seine and on the fringes of the Armorican Massif (see below: Fig. 13). As an example, at Louviers in the Eure department, almost 27% of the polished axes are produced from tertiary flint (Giligny 2005).



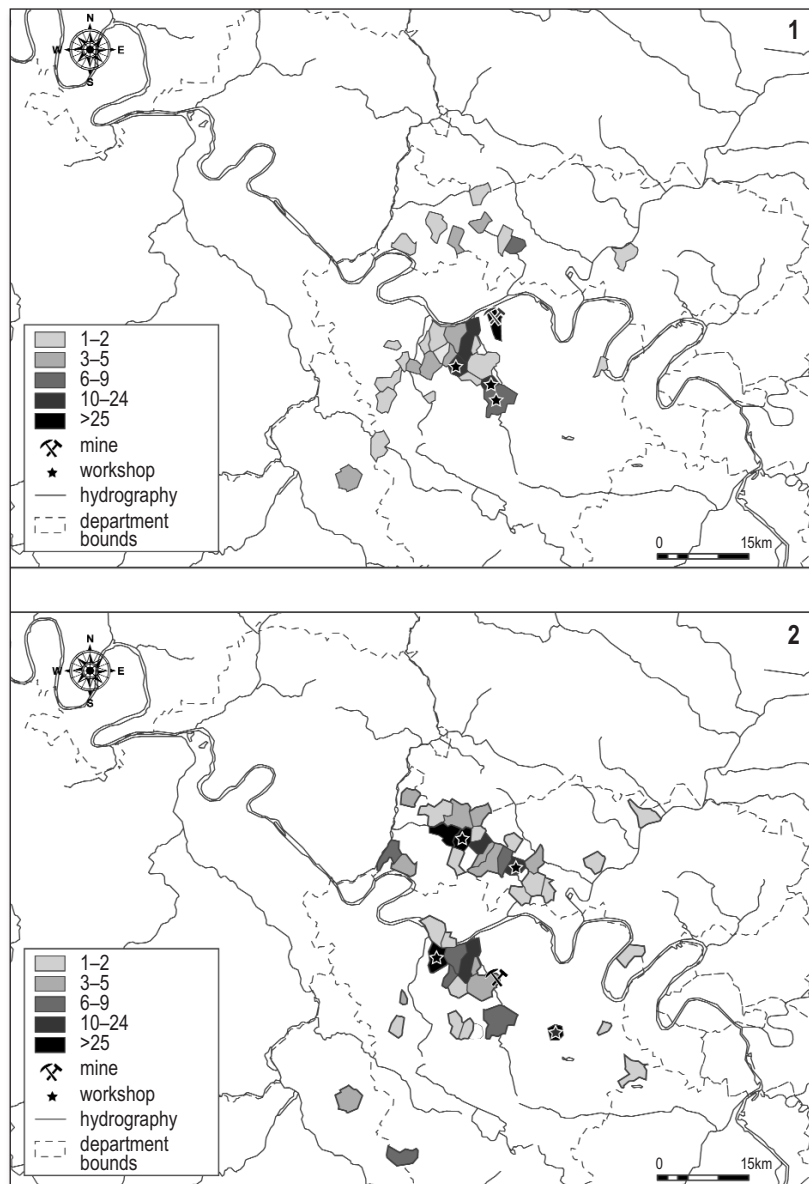


Fig. 7.

Spatial distribution of axes.

- 1: tertiary flint – bifacial pieces and roughouts;
2: secondary flint – bifacial pieces and roughouts.

On a regional scale, it is clear that products were transported away from places of manufacture and over distances of several dozens of kilometres from the 'roughout stage' onwards, including some very rare bifacial preparations. The continuation of this compilation will allow us to define more precisely the successive boundaries beyond which different stages of the reduction sequence are no longer represented.

The geographical quantification of polished axes has been realised on a restricted regional scale (Yvelines and Val d'Oise) by sub-dividing the study area into zones north and south of the River Seine (Fig. 9). Distribution disparities are striking, for flint as well as sandstone and exogenous hard rocks. Tertiary flint is more abundant south of the Seine, where the axe factories and the Flins-sur-Seine mine are situated. Tertiary flint and secondary flint are the

dominant material in this area in approximately equal shares (38 and 35% respectively). Secondary flint is represented at higher proportions in the northern zone (51%) while tertiary flint is rather more scarce (only 12%). Sandstones and exogenous hard rocks are more abundant in the northern part, particularly dolerites which are thought to be of Armorican origin (Plussulien, Côtes d'Armor; Mancellia in Lower Normandy).

Various comments can be made regarding these patterns. The low proportion of axes made of bartonian flint north of the Seine can be explained, in part, by the lack of known flint mines in this area. By contrast, several mines working cretaceous flint are known on the northern border of the study area, together with knapping areas scattered along the Vigny anticline. Local secondary flint is more commonly exploited in this area, which may indicate that the Seine served as a boundary to the diffusion of bartonian flint axes further north. That said, there may be other qualities to the evidence that we need to consider. Cretaceous flint may have been more widely available to the north of the Seine, but the commonly restricted size of nodules often placed constraints on the length of finished axe blades. This was not so much the case with bartonian flint, and this may have influenced the social, economic and symbolic importance attached to those blades that did circulate north of the river. This was certainly possible, as the river did not serve as a barrier to the circulation of axe blades made in other exogenous materials which originated in the southwest (e.g. the 'hard rocks' and bathonian flint). In proportional terms, these are better represented in the north.

At present, the systematic mapping of sandstone and hard rock productions has been realised between Paris and Le Havre. Axes have been arranged in groups according to their attested or probable sources (Table 2). Their broader distribution has also been analysed in relation to their production areas, where known (groups A to D, Fig. 10) (Le Maux 2006a and b, 2007).

Group A is represented by quartz sandstone, sandstone and limestone axes which are considered to be local/regional productions. Whether their sources were in the Val-d'Oise, the southern part of the Yvelines, the Eure-et-Loir, the Essonne, or even the Fontainebleau Forest, people would have been able to procure the raw materials in one or two day trips from their villages or to obtain this material rapidly through exchange. Group B consists mainly axe blades made of ordinary dolerite and of A-type



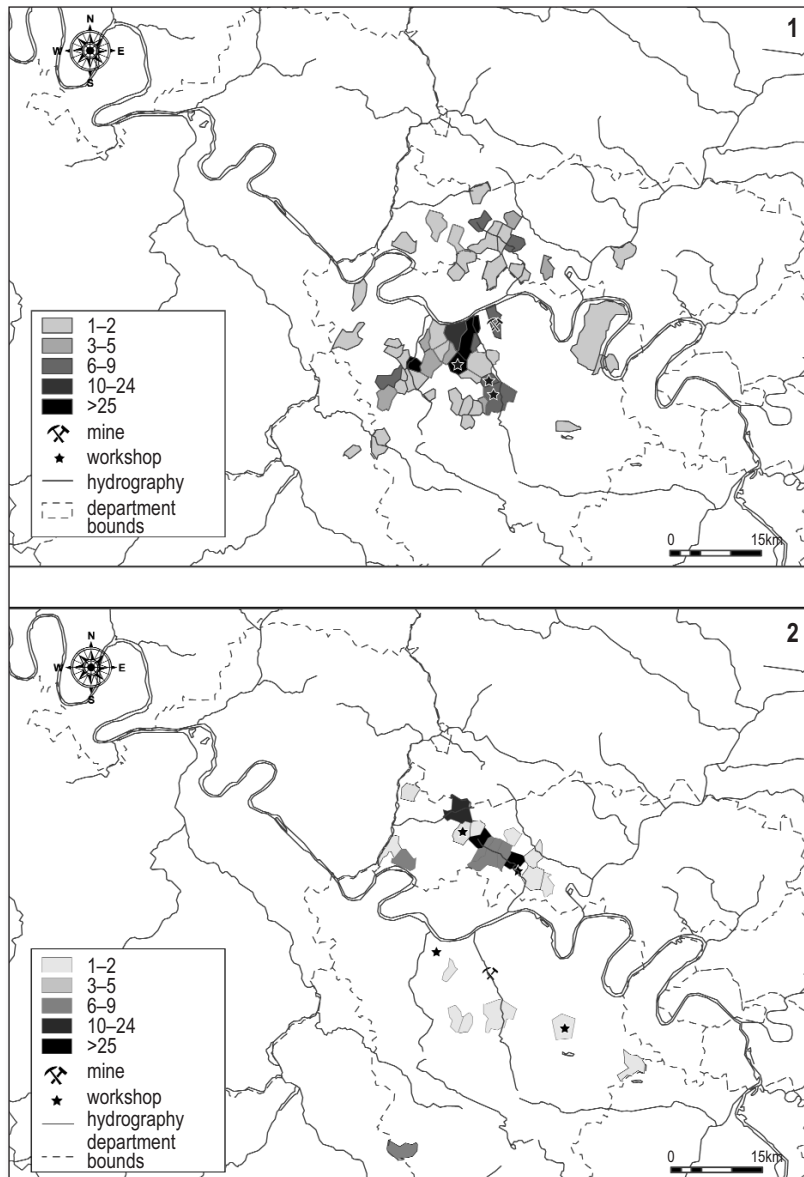
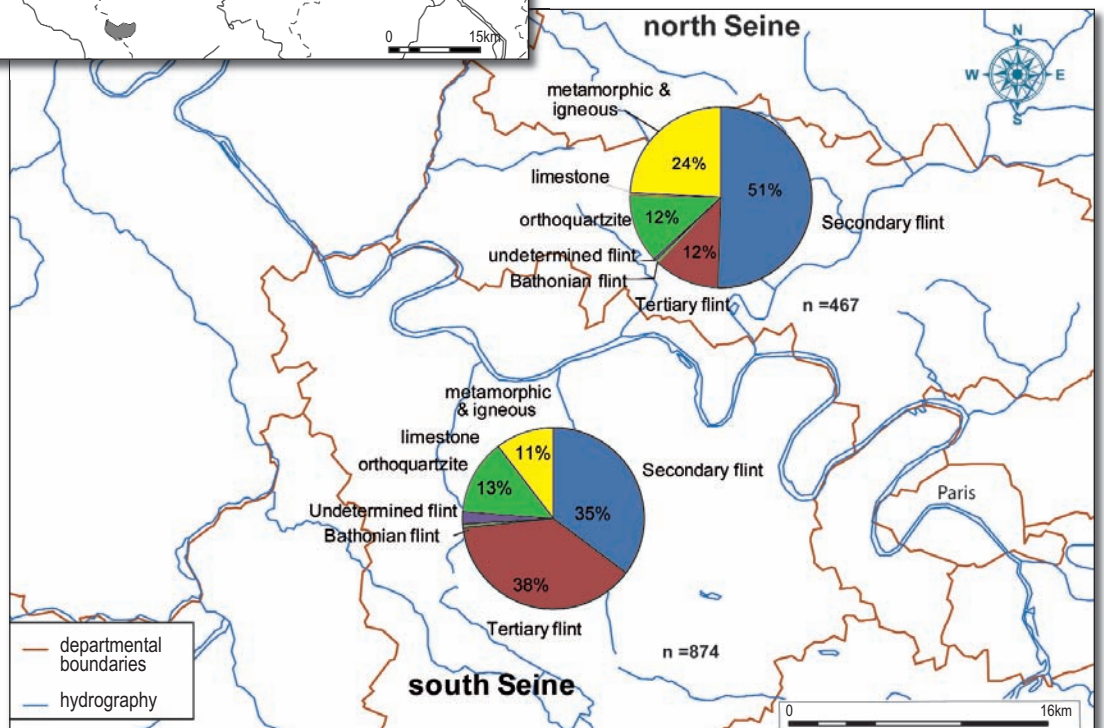


Fig. 8.
Spatial distribution
of axes.
1: tertiary flint – axes;
2: secondary flint – axes
(DAO C. Riquier,
UMR 7041).

Fig. 9.
Frequencies per raw
material of polished
pieces originating from
the west of Paris
north- and southwards
of the Seine river
(Map :
C. Riquier/F. Giligny).



metadolerite, of fibrolite, basalt and tuff as well as rhyolite. Axes produced from disthene, epidiorite, pteridotite, diorite, hornblendite and C-type metahornblendite are less frequent. Those made from occasionally spotted schists, from gneiss, quartzite, granite, greywacke, occasionally speckled hornfels, porphyry and lamprophyre are likely to originate from the broader Armorican Massif. These axes testify to west-east diffusion, from the broader Armorican Massif over distances varying between 50 and 350 km (Cabanis 1987; Cogné & Giot 1952; Fromont 1998; Le Roux 1990 and 1999; Paillet 2007). Sources situated in the Central Massif cannot be excluded however; some of these axes are made from tuff and basalt and certain types of fibrolite (Sumerly *et al.* 2001). Group C constitutes of axes made from sodic pyroxenite i.e. jadeitite, eclogite, omphacitite followed by serpentinite and other atypical materials like glaucophanite and distinct alpine amphibolites. These axes, originating from the Alps, are spread over 450 to 750 kilometres from south-east to northwest (Pétrequin *et al.* 2007; Ricq-De-Bouard 1996; Thirault *et al.* 1999). Group D is composed of pelite-quartz and certain chorito-schiste rocks probably originating from the Ardennes or Vosges. These are rock implements crossing from northeast or east over distances varying between 250 and 450 km (Pétrequin & Jeunesse (dir.) 1995). Finally, group E contains indeterminate pieces.

These varied distributions are interesting in their own right, but also highlight the potential

	Secondary flint	Tertiary flint (bartonian)	Exogeneous Bathonian flint	Undetermined flint	orthoquartzite	limestone	metamorphic & igneous	Total
north Seine	236	54	3	2	79	2	113	499
south Seine	308	333	6	19	57	0	91	781
total	544	387	9	21	136	2	204	1280
north Seine (%)	47,3%	10,8%	0,6%	0,4%	15,8%	0,4%	18,2%	100%
south Seine (%)	39,4%	42,6%	0,8%	2,4%	7,3%	0%	5,5%	100%
total	42,5%	30,2%	0,7%	1,6%	10,6%	0,2%	10,5%	100%

Table 4.
Occurrences and frequencies of the materials of polished axes north and south of the Seine river.

Table 5.
Occurrences of rock types per department and per large source areas.

Type de roche	Yvelines	Eure-et-Loir	Val-d'Oise	Oise	Eure	Seine-Maritime	Autres (n=<22)	Total	Zone de provenance	Total
grès			1		1	1		3	A	
grès-quartzite	81	14	57	17	34	20	3	226	A	
calcaire	2				2		1	5	A	
zone corticale de silex						2		2	A-----	236
disthène	1							1	B	
épidiorite					4	2		6	B	
péridotite	2							2	B	
diorite				1	8	3	4	16	B	
dolérite	68	18	19	15	173	76	21	390	B	
métadolérite de type A	10	5	4	6	50	38	1	114	B	
hornblendite							1	1	B	
métahornblendite de type C				3	1		2	6	B	
fibrolite	3		1		14	1	4	23	B	
schiste	1		4		1	2	3	11	B	
schiste tacheté			1					1	B	
gneiss						2		2	B	
quartzite					2			2	B	
rhyolite						4		4	B	
granite					2	1		3	B	
grauwacke							1	1	B	
cornéenne	1				3	3		7	B	
cornéenne tachetée			1					1	B	
tuf volcanique						1		1	B	
basalte						1		1	B	
porphyre				1	1			2	B	
lamprophyre						3		3	B-----	598
éclogite	10	1	6	14	28	10	2	71	C	
éclogite, jadéite, omphacite	15	1	10	4	17	8		55	C	
jadéite	4		5	3	20	7		39	C	
omphacite	1		1					2	C	
serpentine	2		1	1	2	2		8	C	
amphibolite alpine			2		2	3		7	C	
glaucophanite	1							1	C-----	183
pélite-quartz	2	3	3		1			9	D	
chlorito-schiste					1	1		2	D-----	11
indéterminé	32	4	20	17	40	25	11	149	E-----	149
Total	236	46	136	82	407	216	54	1177		1177



Fig. 10.
Axe factories and attested or probable procurement sources sorted by zones (from A to D).

Zone A (local and/or regional procurement):
1. Montmorency Forest ;

Zone B (armorican procurement):
2. Le Pinnacle (Isle of Jersey); 3. Plussulien;

Zone D:
4. Plancher-Les-Mines, and rocks originating from the Ardennes and the Vosges;

Zone C (alpin procurement):
5. Susa valley;
6. Mont Viso;
7. Mont Beigua (Voltri massif), Central Massif;
8. metadolerite outcrops of the Thiviers-Paysac facies)

(Map : N. Le Maux and L. Jammet-Reynal)

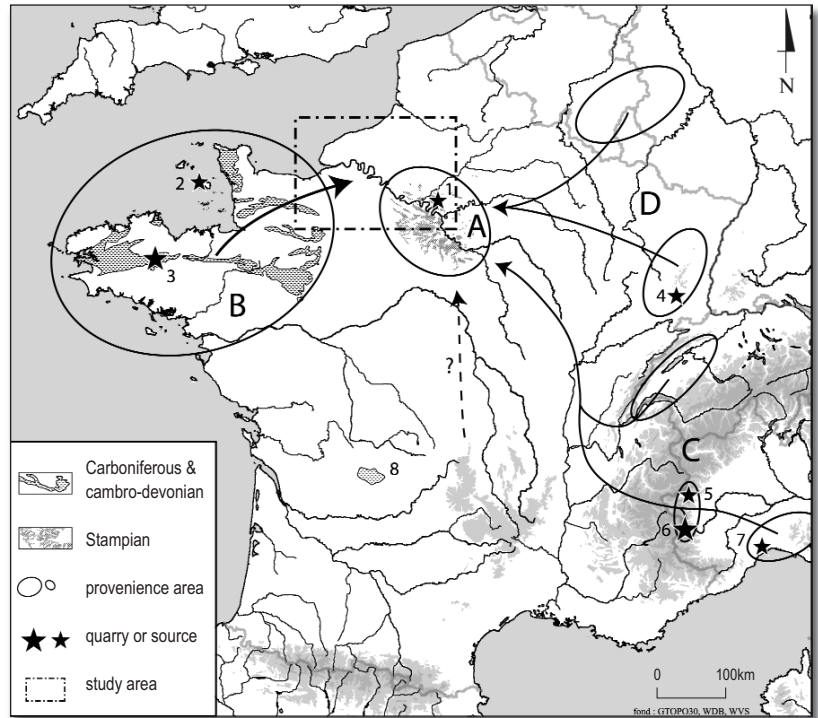
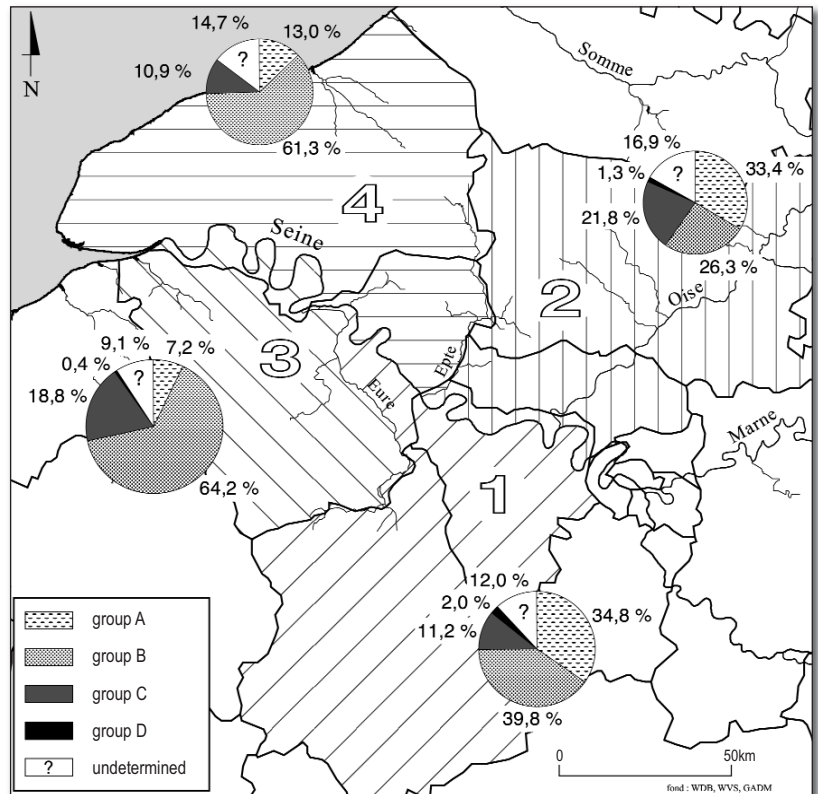


Fig. 11.
Representation of the diffusion according to the rock groups following the natural geographical setting.
Map:
N. Le Maux and L. Jammet-Reynal.



of rivers to serve as barriers and/or as routes of communication/exchange. Four geographical entities, limited by the Seine and its tributaries, have been defined within the study area (Fig. 11). Set against the distribution of axe blades from different sources or source areas, these reveal some potentially significant trends. The Seine is rather favourable to communication

and procurement networks. By contrast, the Epte and Eure rivers appear to represent exchange limits. As a consequence, in Upper Normandy only axes made from exogenous hard rocks, mainly from group B (dolerite group) are found while axes made from the materials of group A from Île-de-France sources (quartz sandstone) do not travel very

far to the west. The strong presence of axes made from quartz sandstone east of the Epte river in the Val-d'Oise and Yvelines departments, most likely signifies proximity to the exploited outcrops (Fig. 12). Thanks to this distribution and to the presence of roughouts and axe factories, it can be assumed that Neolithic

groups procured their raw material in an occasional manner from a series of small sources situated along the Stampian sandstone formations from south, as at Anneau (Dubois & Verjux 1991a and b; Leriche 2005) to north, as at Piscop in the Montmorency Forest (Tarrête 1977).

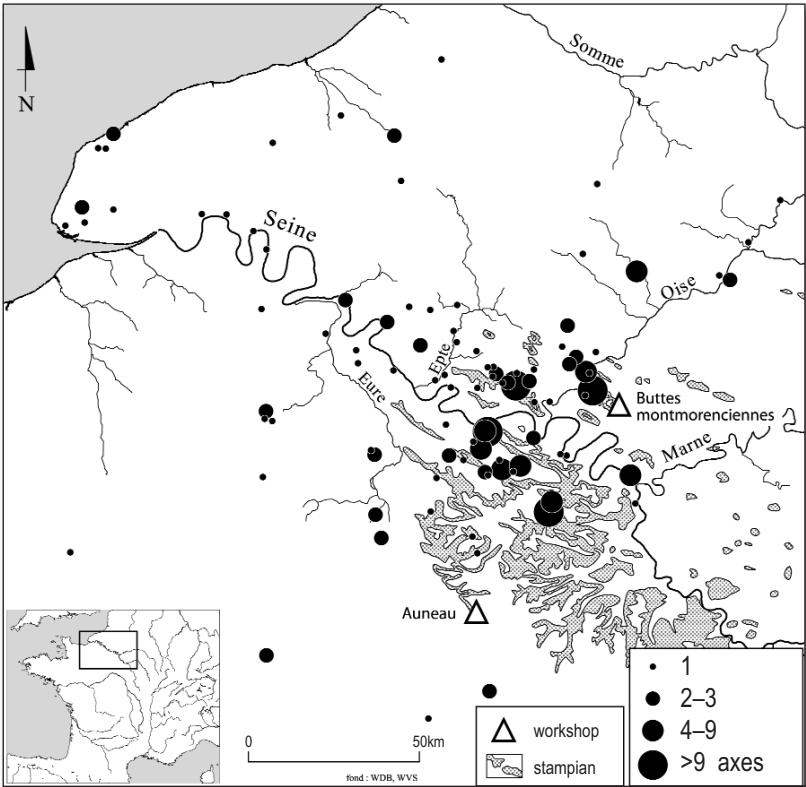


Fig. 12.
Density per commune of axes and roughouts made from quartzite sandstone in relationship to the outcrops of the Stampian buttes (outcrop of quartz sandstone potentially exploited by neolithic people).
Map:
L. Jammet-Reynal.

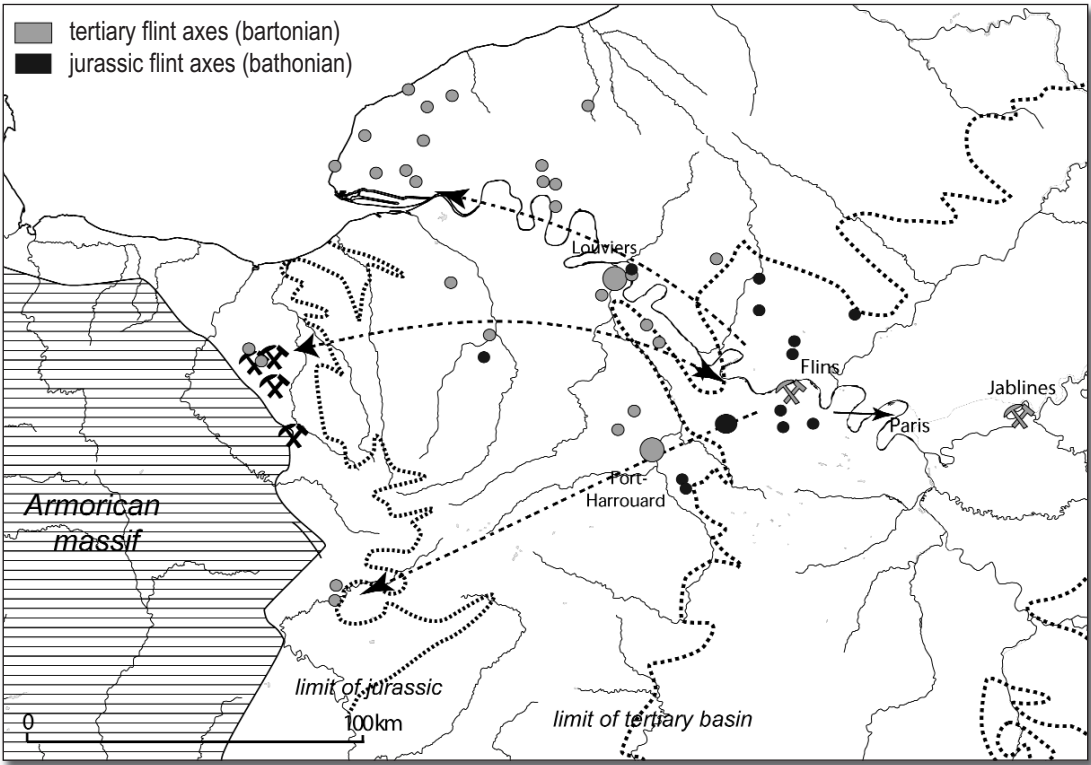


Fig. 13.
Distribution of axes made from bathonian flint originating from Lower Normandy and of axes made from bartonian flint recovered from the Caen and Alençon plains.
Map:
C. Riquier/F. Giligny.

Axes made from tertiary flint are also distributed as far as the Seine outlet and even farther along the Armorican Massif in the Caen-Argentan plain (Fig. 13). This distribution pattern suggests reciprocal circulation networks given that axes made from bathonian flint as well as some dolerite axes and further armorican material may originate from this area. A global geographical and chronological approach is required to link the flint productions of the western part of Île-de-France and those originating from Upper and Lower Normandy. Such an analysis will enable the evaluation of reciprocal influences and the position of each production site or mine complex.

Chronology

The dating of the flint axes is somewhat problematic and in the absence of excavated evidence from production sites, is based on data from finds in other settings. On a regional scale, blades are known from Villeneuve-Saint-Germain (VSG) contexts, as at Poses 'Sur la Mare', where two polished axes were made from "rather granular red-pinkish coloured rock with brown spots" and another from heated secondary flint (Bostyn *et al.* 2003: p. 135). According to these data and those originating from the Paris Basin, the production of axes made from tertiary flint seems to start towards the end of the VSG, for example at Ocquerre 'La Rocluiche' (Seine-et-Marne) (Praud *et al.* 2002). During the Middle Neolithic, flint axes are much more frequent. At Louviers 'La Villette' (Eure) for example, axes made from secondary flint constitute 25% of Chasséen assemblages, while those made from tertiary flint represent 28% (Giligny 2005). At Boury-en-Vexin (Oise), bartonian flint is also significant, with 14 polished axes made from this material, compared to 15 made from Cretaceous flint (Augereau & Hamard 1991). In those Late and Final Neolithic collective burials which could be investigated, secondary flint is most commonly represented. Tertiary flint is present, but in a more occasional manner, as at Luzarches, 'Compant', Presles II 'La Pierre Plate' or L'Etang La Ville 'Le Cher Arpent'. Knapping waste, flakes and blades as well as arrowheads made from tertiary flint are present, reminding us that this material was not used solely and exclusively for polished axes.

Chronological information on polished artefacts made from hard rocks and quartz sandstone enables us to put forward an interpretive model of procurement strategies during the

Neolithic (Le Maux 2007). This information and the model are enhanced by chronological data originating from the typological seriation of "danubian" adzes and large alpine axes made from alpine raw materials (Le Maux TBP; Pétrequin *et al.* 2008).

The break-down of communications and of procurement networks at the end of the Linear Pottery Culture period (Farruggia 1992) is marked here by the decrease, indeed, the cessation, of rock procurement from eastern France and beyond. This is the case for the amphibolites, which appear only by the late phase of the Linear Pottery of the Paris Basin (Watté 1990), and for the phanites of Belgian origin (Le Maux 2007, in print). Access to new local sources (quartz sandstone) or new diffusions like the alpine axes (made from jadeitites, eclogites and omphacites), and the beginning of the procurement of dolerite axes originating from the Armorican Massif can be seen as a reaction to the break-down of these procurement networks. Moreover, these chronological data are consistent with the first alpine exploitations and also with the early colonisation of the Armorican Massif by the VSG culture. The presence of rhyolite and fibrolite in VSG contexts supports this suggestion. Other materials like serpentinites, schistes and hornfels seem to appear later, during the Middle Neolithic period. There is a clear increase in dolerite and metadolerite materials including those of A-type, from the Middle Neolithic I and II on, which may reflect a strong network of exchange and cultural relationships between the Armorican Massif and the western part of the Paris Basin. The results match the dating of the extraction sites of Mont Viso (Pétrequin *et al.* 2006), of Pinacle on Jersey (Patton 1993) and even of Plussulien (Le Roux 1999) as well as of the workshop in the dwelling at Auneau (Dubois & Verjux 1991a and b), thus constituting probably the main procurement sites.

With the exception of dwellings, detailed available data concerning the Late and Final Neolithic, i.e. the Seine-Oise-Marne culture, the Gord-Deûle-Escaut culture, the group of urns with relief decoration (Groupe des Urnes à Décor Plastique) and the Bell Beaker culture are scarce. Thus, we have preferred to assemble the Late and Final Neolithic cultures. As a matter of fact, the material originating from collective burials can only be assigned to successive global entities up to the Early Bronze Age, given that these features are subject to reuse and rearrangement (Billard & Verron TBP). Most of the time, worn-down adzes made from rare materials (fibrolite, jadeite), perforated and



reused as axe-pendants are recovered. In these same monuments, real axe blades, most often made from flint, sometimes from quartz sandstone and very rarely from exogenous hard rocks are found (Sohn 2001).

Despite these data we lack well-dated axes embedded in stratigraphical contexts to study the circulation rhythm of these materials. Thus, the most abundant productions appear all by the early Neolithic (excepted the A-type meta-dolerite), increase during the Middle Neolithic while their circulation seems to last until the Final Neolithic or to break down depending on the different cases (Le Maux 2007, forthcoming).

Conclusion

New mines and workshops have been documented during this research in the Seine valley. Unfortunately, dates are still missing to give a better chronological frame. The long distance diffusion of some products is already demonstrated but archaeological contexts for those imports are not always available.

At a regional scale, the Seine seems to be a barrier to axe circulation, especially for the tertiary flint axes which are produced on the left bank and found rarely on the right bank. Although, products circulate at different stages from the mines or workshops: from roughouts to axes ready to be polished. For extra-regional products, coming from the armorican massif or the Alps, the Seine valley seems to be a “traffic lane” and important axis for exchange and long-lasting networks during the whole Neolithic.

Mines and workshops seem to be an important structural element within Neolithic territories. It remains to be seen to what extent these regionally organized territories with mining complexes played a role in the circulation of everyday tools as well as for prestige items such as exogeneous axes in Alpine rock.

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Vin Davis

Mark Edmonds

A time and place for the *Belmont Hoard*



Abstract

This paper documents recent work on Cumbrian axes, a particular form of stone axe blade produced at some of the outcrops of stone which run through the Central Fells of Cumbria. Associated most closely in the literature with Group VI, these outcrops were used primarily for the making of roughout axes, a focus reflected in the many thousands of blades or blade fragments that have been found across the country.

Survey over the past twenty years or so suggests that axe roughouts were the principal form to be realized across the entire source area. However, the specific chaînes opératoires of working seem to have varied from one part of the source area to another.

Evidence for the distribution of Cumbrian style roughouts is presented and tested using geochemical characterisation. The source was certainly a communal monument, a place where the paths of different communities overlapped. However, the making of specific forms of blade was sometimes concentrated in specific parts of the area, suggesting a complexity in forms of access and in traditions of technical knowledge.

Introduction

Sometime around 1867, a remarkable discovery was made by workmen cutting trenches for a new farmhouse at *Steadman's Howe*, near Penrith in Cumbria. Amidst the stone and soil, they uncovered three large stone axes, all of them intact and made of a distinctive dark green stone. The *Belmont Hoard* soon attracted the interests of antiquarians and archaeologists working in the region. Within a few years of their discovery, R.D. Darbishire had made plaster casts of all three, which he presented to the British Museum in 1873, the same year as he published notes on the recovery of further blades, hafts and related Neolithic material from Ehenside Tarn (Darbishire 1873). Labelled as "*Casts of polished celts, dark green felsite from Steadman's Howe, Penrith ... found 2ft deep in draining*", the replicas are still available for study.

Fig. 1.
Casts of the
Belmont Hoard
made by R.D. Darbishire
and presented to the
British Museum in 1873.



After their discovery, the three original blades were retained for some years by Mr Williamson, the owner of the farmhouse. In time, he gave one each to his three grandchildren, who subsequently moved away from the area. It took another 70 years before the three blades surfaced again, at a meeting of the *Cumberland and Westmorland Antiquarian and Archaeological Society* held in Durham in August, 1936. By this time, one of them had been dropped and had snapped in half, the repaired fracture clearly visible in the photo-

graphs published with a detailed description the following year (McIntyre 1937:152–154, plate facing p.132). In keeping with the conventions of his time, McIntyre rejected Darbishire's use of the terms *Felsite* and *Felstone*, using *Greenstone* to characterise the material from which the blades were made. He went on to describe them as belonging to a group of thin-butted axes which was *characteristic of the area*.

From this point onwards, the movement and associations of the blades become difficult to track with confidence. Two of them are mentioned in a letter from Edward Wilson to another Mr Williamson (presumably a descendant), sent from the Inglemere Hotel, Arnside, on the 3rd of June 1960. In it, he reports how they were brought to the attention of Glyn Daniel at Cambridge, who confirmed their Neolithic date, though this seems to have been based on the close scrutiny of photographs rather than the blades themselves. After this, very little is known. The *greenstone* hoard gets a mention in Clare Fell's gazetteer, but is recorded as privately held (Fell 1964:46). Only the BM casts were available for study when one of us (ME) began his doctoral research on axes and quarries in Cumbria in the mid-1980s, a situation that remained unchanged a few years later, when the hoard received a further mention in *Stone Axe Studies II*:

"...three polished axes of Cumbrian type, which were found together at Belmont, near Penrith, are in private hands and not now available for study, but from the published photograph and description they appear to be of Group VI or a similar rock, and are typologically similar to axes from the Ehenside Tarn settlement" (Fell & Davis 1988:75).

There the story might have ended, at least so far as archaeology is concerned. However, the hoard surfaced again in 2006, when it was offered for sale at an auction in North Yorkshire. There it was acquired by an antiques dealer who subsequently displayed the blades for sale in an antique shop in York, less than 2 minutes' walk from the table at which this paper is being written. Although the dealer had no desire to split up the hoard, offers for individual blades seriously tested this resolve, leading one of us (RVD) to purchase all three in order to keep them together and 'in view'.

The recent biography of the Belmont Hoard is not unusual. However, it does provide a sharp illustration of the contingent conditions that shape our records. After the serendipity of dis-

Fig. 2.
The Belmont Hoard.



covery, the three blades have been circulated as gifts amongst kin, handed down across generations, recast as scientific specimens and finally re-emerged as subjects of connoisseurship, commodities available for purchase to the highest bidder. This is probably just the tip of the iceberg. We do not know just how many hands they have passed through, how they were stored and/or displayed, nor the questions, conversations and recollections that their handling has prompted. All that we can say with some confidence is that their biographies *prior* to deposition at what would eventually become known as *Steadman's Howe* were probably just as complex and no less tied to the identities and interests of people (Edmonds 2004). It is with a view to charting at least some of that prior complexity that this paper has been prepared. In what follows, we use several lines of evidence to sketch what we can of the conditions in which the blades were originally made, combining petrological and geochemical characterisation with the results of ongoing survey at their source and with the insights provided by excavation and other chance discoveries across Cumbria.

Origins and forms

"...The salient features of the Cumbrian Axe, which occurs both in very large (17–9 inches) and smaller sizes (under 9 inches), are its long, narrow proportions, lateral facets, the maximum width usually being about the middle of the implement and not at the cutting edge, and a distinct 'waisting', or constriction, towards the butt end, which is sometimes squared and often ground to an edge..." (Fell 1964:40).

Unfolding over some 140 years, descriptions of the Belmont Hoard reveal the development of archaeological knowledge about the forms, sources and distributions of *Cumbrian* axes. There is the changing vocabulary used to describe the raw material, which runs in parallel with ever more specific links made between these distinctive blades, and the region of north-western England in which they are most commonly found. Accelerating in the first half of the 20th century, these changes were driven by characterisation studies undertaken by the *Implement Petrology Committee*, by the mapping of outcrops in the Cumbrian Fells and by comparative analyses of the morphology of the



blades themselves (Grimes 1979; Manby 1979). Over much of this time, work on several of these fronts was both undertaken and/or encouraged by Claire Fell, who effectively established the baseline from which much recent work has developed.

Cumbrian or Cumberland axes were first identified as a category in the later nineteenth century. In *Ancient Stone Implements*, Sir John Evans provided an engraving of a striking example from near Pendle in Lancashire (Fig. 3), noting that 'felspathic' blades of this form had a distinctly north-western distribution, being particularly well represented in Cumberland and Westmorland (Evans 1872:106–7). Made some 70 years before the identification of worked outcrops in the Cumbrian Fells, Evans' observations were based entirely on details of blade morphology and distribution, an approach which continued to characterise most research in the early 20th century (e.g. Smith 1927; Varley *et al.* 1940). This work reinforced the Cumbrian connection, extending it when several authors started to refer to some of the larger blades as *Cumbrian Clubs*, the name inspired by ethnographic parallels for hand-held stone blades, amongst them the *Mere* of New Zealand. As Claire Fell noted in a later review: "...a use as clubs is doubtful..." (Fell 1964:40). However, the regional attribution *was* valid, and independently confirmed in the middle decades of the century with the identification of some of the quarries for Group VI axes in the Central Fells, particularly on the crags around the Langdales (Bunch & Fell 1949; Fell 1951, 1954; Houlder 1979; Keiller *et al.* 1941; Plint 1962, 1978). Since then, there have been further refinements of the category. As the Belmont Hoard demonstrates, there is a measure of variety in the form of *Cumbrian* blades, particularly the extent to which a 'pinch' or waisting was created near the butt. Fell herself acknowledged this, talking of *related forms* to note the somewhat flexible boundaries of the category (*ibid.*). In his review of axe typologies in Yorkshire, Terry Manby applied the term only to larger blades, excluding those with a maximum length of less than 15cm (Manby 1979:65). This has some validity, particularly where there is a concern to distinguish between original and reworked forms. Here however, we follow Fell in including the wider size range, on the basis that the form itself is sufficiently distinctive that it reflects recognition of the category and a definite choice on the part of the original makers.

Building on these foundations, more recent research has tended to concentrate on either petrology or on evidence for the quarrying and

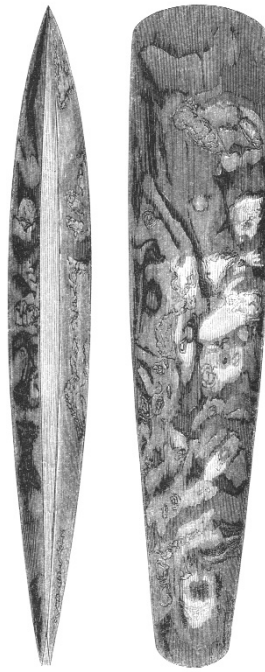
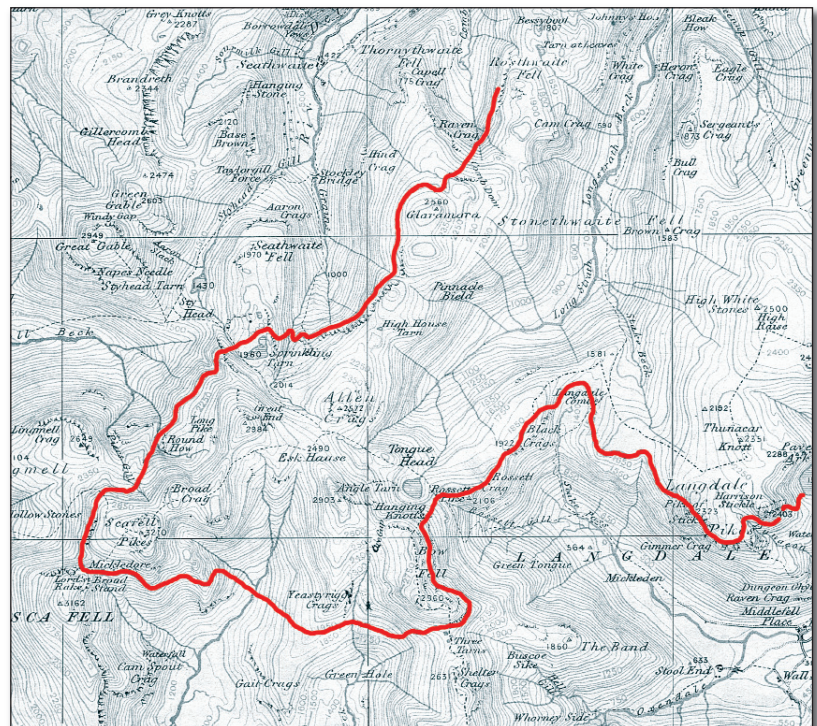


Fig. 3.
Cumbrian Blade from
Pendle, Lancashire
(Evans 1872: 106).

Fig. 4.
The central fells of
Cumbria, showing the
general extent of the
Seathwaite Fell Tuff
formation.



working of stone up in the Fells. We now know, for example, that evidence for extraction and working can be found over a much larger area than was originally supposed, an area recently reviewed by Woodhall (2000). The rocks which crop out around the Great Langdale and Scafell Pike areas of central Cumbria form part of the Borrowdale Volcanic Group (BVG) (Oliver 1961; Woodhall 2000). These are altogether around 7500m thick, consisting of sub-aerially erupted basaltic, andesitic, dacitic and rhyolitic lavas and pyroclastic rocks; volcanoclastic sedimentary material deposited in shallow subaqueous environments. There are also numerous high-level sills. These rocks are calc-alkaline in composition with continental margin affinities. The Seathwaite Fell Tuff Formation, a constituent member of the BVG, consists of up to 540m of subaqueously deposited volcanoclastic sandstone, with intercalations of pebbly sandstone, breccias and tuffs. Variability in the origin and composition of these volcanoclastic rocks results in substantial variability in the qualities and range of raw materials. This also causes rocks at outcrop to vary considerably in colour, texture and appearance. The tectonic evolution of the central Cumbrian landscape has also produced significant faulting, which impacts on the form and the weathering of the rocks.

The stone which drew people up from around 6000 years ago is principally, but not exclusively, situated on or adjacent to an outcrop of fine-grained tuff within the Seathwaite Fell Tuff (SFT) horizon. At outcrop, the tuff



weathers to a distinctive olive green, which is a visually distinctive feature of the landscape. The weathering products of the SFT range in colour from a cream to reddish-brown, depending on the depositional history. The particular horizon most favoured for working crops out between the 500–900m contours and continues for a distance of around 19km.

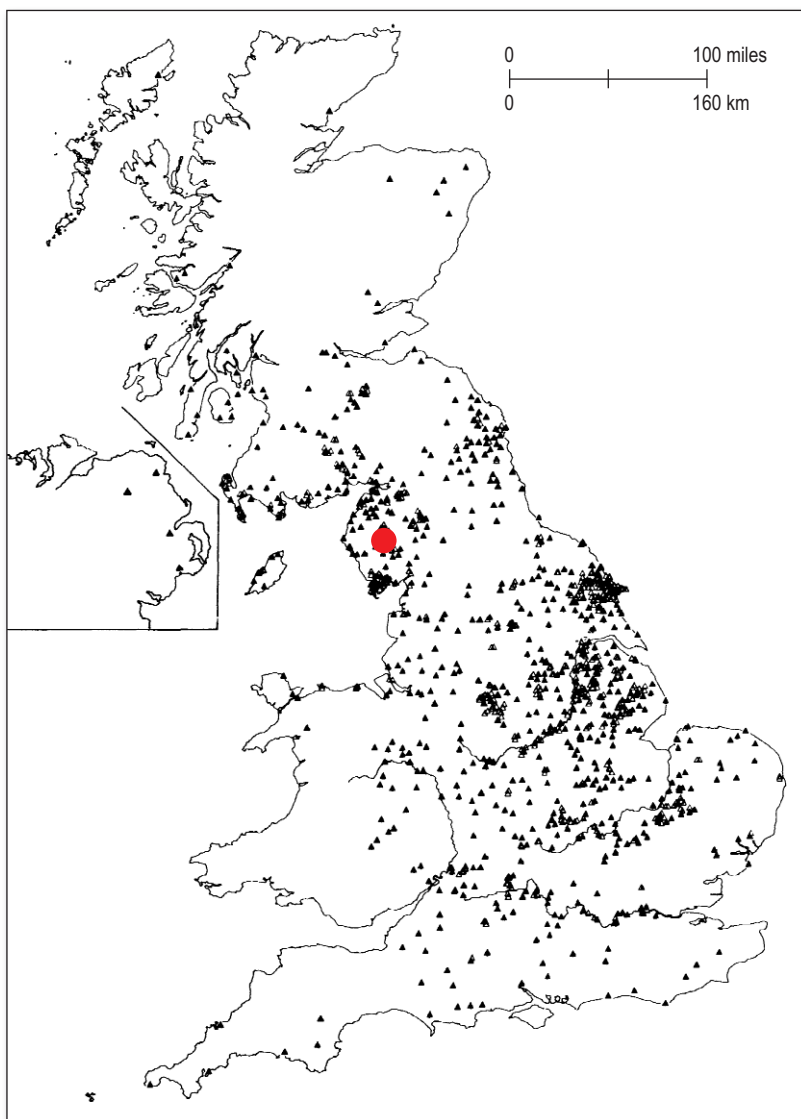
The tuff presents itself in ways which influenced the character of prehistoric working. In places, it is heavily fractured and resists good work; in others, it takes the hammer well and can be flaked as effectively as good quality flint. Not all outcrops with these potentials show signs of working, but there are many that do, and many more which are not yet exposed on the surface. The outcrop occurs as near vertical crags, benches, bays and overhangs formed where joints and minor faults have been worked upon by water and ice. Elsewhere, faults were attacked more aggressively by the elements, splitting the stone and creating

extensive blockfields and screes. As survey continues, more and more areas of working are brought to light across an increasingly large part of the Central Fells, so much so that it is best to talk in terms of a *source area*. However, some of the most substantial and remarkable deposits are concentrated on the fells around the Langdales, where several hundred exposures of quarries, working floors and screes of flakes, hammers and broken roughouts have been recorded (Bradley & Edmonds 1993; Claris & Quartermaine 1989).

Work on the source area has gone hand in hand with the characterisation of blades across Britain and Ireland. Combined with data on contexts of recovery and the special treatment sometimes accorded to individual blades, this work suggests that as on the continent, the axe was both a vital tool and a potent symbol from an early stage; an extension of the hand and an important *token of identity and value* (Edmonds 1995, 2004). Axes mattered. Knowing how to make, use and carry them spoke in subtle ways about the identities of people; the place they occupied in the community and in the broader social landscapes of the time. Worked, maintained and reworked when needs arose, individual blades, like human bodies, often changed over the course of their lives, making them a rich source of metaphor for the journey from birth to death. They also built up biographies and it was this that made them important as *tokens of value*; circulating in the various exchanges that defined relations between people. Axes were good to think with in such settings because they carried people with them. This made them valuable in everything from face to face barter and marriage payments through to more ceremonial transactions that determined the standing or renown of individuals. In a world where politics and identity were articulated through the use and circulation of things, axes were often powerful. Some may have even had names.

There was, no doubt, a good deal of variety in this. Some blades were made of material from secondary, derived, sources and many were probably used, reworked and discarded without much reflection. That said, the significance of many blades often went beyond this, involving ideas that were implicated in all stages of the *chaine opératoire*. Put simply, axes mattered and it therefore also mattered how one obtained them; what stone was used, where it came from and how it was approached and worked. In other words, part of the significance attached to blades lay in stories about the places where they had been born, the jour-

Fig. 5.
The national distribution
of all Group VI blades,
showing source area
in central Cumbria
(Clough & Cummins
1988).



neys and the work involved in bringing them into the world (Whittle 1995). These were not entirely new ideas. Their ultimate source lay in areas like the Alps, and in the constellation of values that had informed the making and circulating of blades on the continent for some considerable time (Edmonds *in press*; Petrequin *et al.* 2008; Petrequin *et al.* this volume).

The vast majority of roughout blades, are found within the region, suggesting that procurement often involved movement on that kind of scale; from areas of more persistent occupation near the coast, on valley sides, or on the broad shoulders of some of the lower hills. These journeys were often made with stock. Though the treeline was up near the crags at that time, pollen and charcoal both indicate that the higher country was kept open by grazing and periodic firing (Bradley & Edmonds 1993). The getting of stone was thus was an episodic event, something that periodically involved a measure of separation from more familiar country and from the residential community. When blades were needed, for use or for exchange, those allowed to make the journey took to the trail. Up the sides of valleys, through dense and tangled dales and along more open ridges, following paths that could take several days to complete. Where the goal of working was to make tools which said something about *identity*, the journey and the separation that it afforded conferred a certain quality on both the act and the artefact (Edmonds 2004). These are the hallmarks of many *rites of passage*, conventions that mark the crossing of important thresholds in life. This also applied to the work itself. It took time to learn, the acquisition of *savoir faire* affording an index of progression in life. And it involved a relationship with the stone that was very intimate, one in which the rock played an active part. It lent itself to particular ways of working and resisted others, stubborn and even dangerous when approached the wrong way. Though there is much that we cannot know, we can assume

that perceptions in the fourth and third millennia cut across the lines that we now draw between history and geology. Technical, historical and even spiritual qualities were all probably important in determining how work proceeded and how it was understood.

These kinds of argument have often surfaced in discussions of the larger *Cumbrian* axes, those with the characteristics defined nearly fifty years ago by Claire Fell. Most have been recovered as stray finds. However, when found on the other side of the country or in specialised deposits such as hoards, it is generally acknowledged that it was the biography of a blade that probably influenced its treatment. Such ideas are fine so far as they go, but there has remained a good deal that we do not really understand. For example, beyond acknowledging their origins in the Cumbrian Fells, we have been able to say very little concerning exactly where and when they were being made. Were they the products of a specific episode of activity, a particular workshop/quarry or tightly defined group of stoneworkers? Across the outcrop as a whole, what kinds of raw material selection were involved, and what was it that mattered; the grain size, the colour, or more broadly, the character and setting of the quarries themselves? And what happened beyond the source? Where did roughout blades go when they were brought down from the mountains; is there anything we can learn from the details of their distribution and treatment in other settings? Such questions are more easily asked than answered. However, detailed mapping and petrological analysis focussed specifically on *Cumbrian* axes can now add a measure of detail to the picture.

At the outcrop

Following on from fieldwork conducted over two decades ago (Bradley & Edmonds 1993; Claris & Quartermaine 1989), one of us (ME) has continued to undertake mapping across the extent of the Seathwaite Fell Tuff formation. This work builds on earlier survey, which was geared towards the discovery, description and technological analysis of exposed deposits of worked stone in a variety of settings. In simple terms, this included exposures immediately adjacent to or associated with evidence for extraction and those scatters that seem to reflect the carrying of stone to camps or working sites on the margins of the highest ground. The former display quite varied characteristics, from the turning over of blockfields and 'open-cast' extraction to the consistent working of vertical quarry faces,

Fig. 6.

Secondary sources, such as glacial erratics, were undoubtedly exploited in different regions (see Briggs this volume). However, blades such as this example, from Speeton in North-East Yorkshire, demonstrate that the circulation of *Cumbrian* and other blade forms extended across much of the country.



a practice that sometimes involved fire setting to help bring blades from the stone. Many of these more dramatic quarries are found in locations which are precipitous or difficult to reach, where working involved a scramble and even exposure to danger. The latter, usually exposed by footpath erosion in a popular area for hill-walkers and climbers, take the form of scatters of working debris and hammer fragments, reflecting the reduction of raw material brought along or down from the outcrops no more than a few hundred metres away. The full extent of these scatters is unknown. However, there is a tendency to find them on areas of slightly more level ground and in relatively close proximity to either becks or tarns, the small streams and glacial lakes that are a distinctive feature of the Fells. It would have been in these sorts of settings that groups making periodic trips to the source would have established camps for themselves and whatever stock they brought with them.

Earlier work had been directed towards characterising the kinds of *chaines operatoires* played

out in different settings. This confirmed that roughout blade production was to a very large extent the only form of working consistently undertaken along the outcrop. It also revealed a variety in the organisation of working. Some exposures showed that all stages of manufacture were undertaken at the quarry face, while others suggested that blocks and blanks could also be transferred from the point of extraction for 'finishing' elsewhere. No evidence for the grinding or polishing of roughouts was found at all – these final stages in blade production were a feature of life in the lowlands, in areas of more persistent settlement that could be reached on foot within a handful of days.

More recent mapping was designed to complement these observations. Conducted over the past two decades and covering the same area, it was directed towards the broken and/or discarded roughouts that are a common feature in many exposures. These had been recorded in earlier work, but only in summary terms and as such, they had contributed little to interpretation. This was in no small part because a thorough programme of prospection and recording was quite beyond the timescale and budget of the earlier work.

From the outset, the scope of survey was set so that it did not include the many roughouts that currently rest in museum collections across the region. Though these are often near complete, reflecting the recognition skills and choices of casual collectors over the years, the majority are poorly or even incorrectly provenanced, making attribution to specific working areas next to impossible. These collections retain a measure of analytical potential. At the very least, the range of forms demonstrates that roughout blades of different shapes and sizes were being produced along the outcrop, and that there was sometimes variety in the form of roughouts being made at individual locations. However, the lack of secure and accurate provenances for so many meant that they could contribute little to the answering of more specific questions.

- * What could the form of roughouts say about the range of forms being produced at the source over time?
- * What light could they shed on the specific character of *chaines operatoires* that complemented or extended the insights derived from studying flake assemblages?
- * Were all forms consistently and equally distributed across the source area, or were some concentrated in specific settings? If the latter, at what scale could variability be observed?

Fig. 7.
Scree of flakes,
roughouts and
quarrying debris above
the Langdale Valley.



Mapping involved a return to the many hundreds of exposures found along the 19km band of tuff. With each visit, screes and scatters of worked material were searched for roughouts, each of which was photographed and described in note form, the notes extending to cover aspects of the scale, composition and setting of the exposure. Stretched over several years, the work has documented several thousand pieces. It confirms the impression from museum collections and from earlier work, that roughout blades were the primary product of the area, and that those blades could take a variety of forms. As such, it makes clear that many of the so-called 'variant' axes, smaller blades found in Cumbria and across the country (Manby 1979), are not simply the result of using and maintaining larger forms. They were, themselves, intended. The work has also thrown up other insights, some of them telling of the history of antiquarian and archaeological interest. On several occasions, roughouts picked from a scatter were found to have writing on them; a number or a name that referred to a particular place; *Mickleden, Pike, Scree* and so on. More than once, the name on the roughout did not correspond to the place where it was discovered. It seems that earlier collectors either returned to the area to scatter their assemblages, or more likely, had 'grazed' across the fells collecting and marking material until the practicalities of carriage led them to discard unwanted pieces like so much ballast.

The characterisation of roughouts was far from straightforward. By definition, it dealt with pieces that had generally been rejected or otherwise discarded in the past and the point at which a piece had left the hand was varied. Some were angular blocks with no more than a few scars, a line of flakes detached along one edge. These could be interpreted as a first attempt at establishing the basic line of an edge and thus a point of departure in realising the form of a roughout. However, there were many where working was so perfunctory that it may have been undertaken to test a block, to listen for a ring of consistency in the stone, or even simply to make use of the hamerstone that would not lie idle in someone's hand. Pieces like these will be dealt with in detail in a final publication on the survey (Edmonds in prep). Here, our primary concern is with those roughouts that had been worked more extensively, where it was possible to say more about the likely form of the blade that was intended and even, on occasion, the reasons why a piece had been set or thrown aside.

One quality to many roughouts had been



Fig. 8.
Surface exposure
of debitage and
worked block.

observed during the first campaigns of field-work in the 1980s. This was the extent to which the flaking of blocks or large flakes had been undertaken to such a degree that the roughout possessed a degree of symmetry in both plan and section. A quality that had a significant bearing on the amount of time and effort required in grinding and polishing, this concern with symmetry varied considerably across the source area. Where evident, it was usually manifest in two ways: in high frequencies of fine, curving thinning and trimming flakes with carefully prepared platforms, and in roughouts discarded late in the process of making, usually because 'end-shock' from a badly aimed blow had caused them to snap in half. In most cases, the primary concern was not with symmetry *per se*, but with the anticipation, during flaking, of the form that the blade would have once it was ground and polished. That this early realisation of a final form was important is reflected in the complete roughouts discarded in many areas. These were often characterised by a very deep flake scar, lump or other irregularity which either broke the line along the side of a blade, or would most likely have required a lot of additional time to overcome during grinding, usually with a significant reduction in the size of the resulting tool. In many cases then, it seems that those making roughouts often did so with a clear idea in their minds (and hands) as to

what the blade would look like when finished. In fact, they were sufficiently concerned that they would often discard quite advanced pieces if the stone in their hands made this difficult to achieve.

Not all discards can be understood in this way. There are many worked to a lesser extent, where there is little in the character or quality of the stone to infer why work was abandoned. There are also roughouts that are to all intents and purposes complete, with principal surfaces carefully flaked and sharp, direct lines defining edges. Some may be chance losses, put down and never returned to in the face of other material and other distractions. Some may have also been left behind when people scattered back downhill to places of more persistent settlement, left in anticipation of a return by individuals who already had all the blades that they required. It may even be that some were left behind as signal deposits, tokens left to mark the end of particular episodes of working. This is difficult to test, but it did happen on other sources, and may have been important where journeys to a source, the work and even the stone itself had a ceremonial or spiritual quality.

As noted above, those roughouts discarded at a relatively late stage reveal variety in the forms that people worked to realise. The full range (and definition) of categories identified during the survey will be discussed elsewhere. Here it is sufficient to differentiate between eight loosely defined forms (see Table 1).

- | | | |
|----|--------------------|-------------------------------------|
| 1. | 5–15cm in length, | wide cutting edge and tapered sides |
| 2. | 5–15cm in length, | narrow with parallel sides |
| 3. | 5–15cm in length, | broad with parallel sides |
| 4. | 5–15cm in length, | possessing Cumbrian characteristics |
| 5. | 16–45cm in length, | wide cutting edge and tapered sides |
| 6. | 16–45cm in length, | narrow with parallel sides |
| 7. | 16–45cm in length, | broad with parallel sides |
| 8. | 16–45cm in length, | possessing Cumbrian characteristics |

Many complete roughout blades were relatively diminutive, measuring between 5 and 15 centimetres in length. Some possessed broad cutting edges while others were more narrow, with more or less parallel sides. The range here would be consistent with the making of tools that we might classify separately, as axes/adzes or even as chisels, and it is worth noting that a very small number of the latter are known from archaeological contexts elsewhere (Kinnes & Longworth 1985). Alongside these were much more massive pieces, roughouts with lengths of between 15 and 40 centimetres, and a few



Fig. 9.
Roughout found in the
vicinity of Stickle Tarn.

which were even larger. These too tended to be morphologically varied. What matters here is that along with a number of diminutive examples, many of these larger roughouts possess most of the characteristics that we associate with distinctive *Cumbrian* blades: a maximum width some way behind the cutting edge; long proportions and a pronounced waisting towards the butt.

The extent to which this final form can be traced in many roughouts is a testament to the skilled working they involved. Realising that form through the slow, almost glacial process of grinding was one thing. It allowed plenty of control and the exercise of judgement on many things; form, balance, lustre and so on. But it ran few risks of catastrophic failure, breaks from which there was no way back. The more seismic act of flaking was far more risky; an ill-judged angle or an excess of force could easily lead to failure. These roughouts were the products of accustomed hands, who could exercise the appropriate levels of control, anticipation and judgement to take a line along the stone and hold it well. On many blades, flaking across both faces was also highly invasive, covering the entire surface and reducing it to such an extent that the height difference between bulbous scars and ridges was very low indeed. Achieving this level of finish is a risky process even when pressure flaking. Using percussion, as was the case here, it is next to impossible without a knowledge of stone, a relationship with material, that takes a long time to mature. It also suggests a keen awareness of the amount of time and effort required for grinding and polishing, and a concern to keep that under control.

The levels of skill in this work reflect the development of technique over the course of

Table 1.
Summary categories
of roughout.



many years. It certainly required a specialised body of knowledge, in every sense of the term. But specialisation in this setting was probably as much a prerogative and a reflection of age and experience as anything else. That may be why the exposures in which some of the finest roughouts are found also include examples where working has not progressed so well; where mistakes have been made, where an edge has been lost and where symmetry has been achieved in only one principal plane. The most likely explanation for these associations is that the pattern of work generally involved a company of people, a company that included older and younger members; those who knew the stone and what it meant and those who were still on the way to making that knowledge their own. If the journey to the source could be thought of as a *rite of passage*, then learning the work, making technique a part of one's body, was also part of the process.

The spatial patterning of roughouts is also very revealing. Most forms are found throughout the entire study area, particularly those which reflect discard at an early stage in the process. By contrast, roughouts with *Cumbrian* characteristics have a far more restricted distribution. They are found on exposures close to quarries on a number of crags that rise above the Langdale valley and on an even smaller number of scatter sites set down from the outcrop, but still within the same general area. Large blanks, many of them snapped in half or with some other defect, occur on Top and Middle Buttress on the Pike of Stickle, in Middle Gully, East Gully and at Loft Crag and Thorn Crag. More diminutive (5–15cm) exam-

ples have also been found in these same locations, and on the flanks of Harrison Pike, which rises c.100m to the south-east of the Pike of Stickle. *Cumbrian* roughouts in both size groups have also been found in the major scree slope (South Scree) that runs down between the Pike of Stickle and Middle Gully, an area that has attracted the interests of collectors for more than fifty years. Beyond the outcrop itself, both large and diminutive forms have been identified on paths leading out to the south and to the north; on the level ground below Harrison Pike, on the margins of Stickle Tarn, and around Stake Beck, where footpath erosion brings a fresh crop of material to the surface each year.

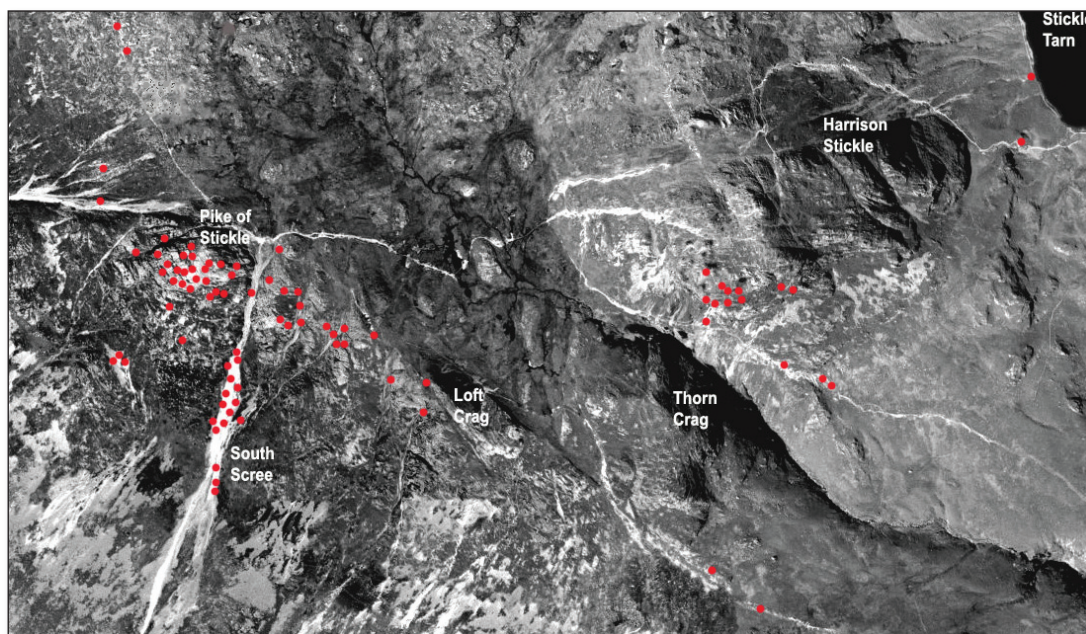
Fig. 10.

Roughout found on the footpath in the vicinity of Stake Beck.



Fig. 11.

Distribution of roughouts with *Cumbrian* characteristics. This reflects the concentration of material within a particular part of the outcrop, albeit across a number of different exposures. The absolute numbers represented are slightly misleading. Variations in density are to some extent a function of the variable size of individual exposures.



Under the microscope

These spatial patterns have a number of implications, to which we shall return. Here, it is more immediately important to note that the impressions gained through mapping are now open to testing by more systematic methods. All three blades can be assigned to Group VI, the definitive petrographic description for which was published nearly seventy years ago (Keiller *et al.* 1941; Registry Entry HPRO.9b – Asset number 1000/08). This simply locates them to the Central Fells but it is now possible to be more specific. The principal Tuff formation favoured in prehistory is quite variable, so much so that a combination of petrographic and geochemical analyses make it possible to assign samples to likely locations within the source area (Davis 1984; Woolley 1989). These combined techniques also provide a basis for comparison with other roughouts and finished blades held in collections across the country.

The analyses reported here involved the re-examination of the 49 thin sections used by Evens and Wallis in the further characterisation of Group VI material over fifty years ago, the 63 geological and 48 archaeological specimens taken in the 1980s (Woolley 1989) and all thin sections of volcanicalstic rock from the National Collection of thin sections held by the *Implement Petrology Group*.

The petrographic characterisation of the three Belmont blades was kindly undertaken by Rob Ixer, and is summarised in *Table 2*. This confirmed that all three were an epidotised tuff and closely similar, particularly blades 1 and 3, which are likely to have come from the same immediate source. All three provide the closest match with the two fine grained Group IV type thin sections in the collections of the British Museum (Natural History), cut from a roughout from Thorn Crag, and collected by Clare Fell.

In mineralogical terms, the fine grained ‘dusty’ composition of most fine grained tuffs can make identifications difficult. However, specimens from two clusters of sites, the first running from Harrison Stickle to Loft Crag and the second, from Middle Gulley to the Pike of Stickle, provided the closest match to the petrography of the three Belmont blades. Plagioclase (oligoclase-andesite) feldspar is identifiable in all sections, sometimes evenly distributed across the rock or concentrated into layers. The opaque phase is mainly ilmenite. The occurrence of epidote in spots, grains, veinlets, patches and vugs, and the comparative absence of carbonate, are diagnostic features of worked stone from both clusters of sites and from adjacent outcrops. These distributions complement geochemical data obtained using back-scatter scanning electron microscopy (SEM) and microprobe analysis on rocks from the same

Table 2.
Summary characteristics
of the petrography of
the *Belmont Hoard*.

Macro/micro	Petrographic features	Axe 1	Axe 2	Axe 3
Macroscopic in thin section	Dusky yellow green 5GY 5/2 on the GSA color chart	*		*
	Greyish yellow green 5GY 7/2 on the GSA color chart		*	
	Distinct planar laminae bedding	*		*
	Feint non-planar laminae bedding		*	
	Sulphide-rich clots	*		*
	Homogeneous matrix	*	*	*
Microscopic	Fine grained	*	*	*
	Indeterminate matrix with very low interference colours	*	*	*
	Angular to sub-rounded rock fragments	*	*	*
	Plagioclase laths	*	*	*
	Patches (spots) of blue-green, pleochroic amphibole	*	*	*
	Epidote rims around sulphide aggregates	*	*	*
	Pyrrhotite	*	*	*
	Chalcopyrite	*	*	*
	White pyrite (FeNiCoAsS)	*	*	*
	Sphalerite	*	*	*
	Cobalt	*	*	
	Carbonate	*	*	*
	Ilmenite		*	
	Quartz	*	*	*
	Chlorite		*	
	Muscovite			*
	Sphene			*



two clusters of sites (Davis (1984), and together suggest that an area between the Pike of Stickle and Harrison Stickle is the most likely source for the Belmont axes.

PXRF analyses and major element analyses were also undertaken on all three blades as part of a broader study with Dr Peter Webb and Dr John Watson, respectively, which compared them to a number of axes and rock samples, all of them assigned to Group VI. The study also

took in large roughouts collected between the Pike of Stickle and Harrison Stickle and a number of Cumbrian Clubs found across northern England. The Langdale 1 & 2 compositions were each obtained from specimens collected from exposures between Langdale Pike and Harrison Stickle. The major element match between the Langdale 1 sample and Belmont 1 is quite remarkable and points to a source between Langdale Pike and Loft Crag.

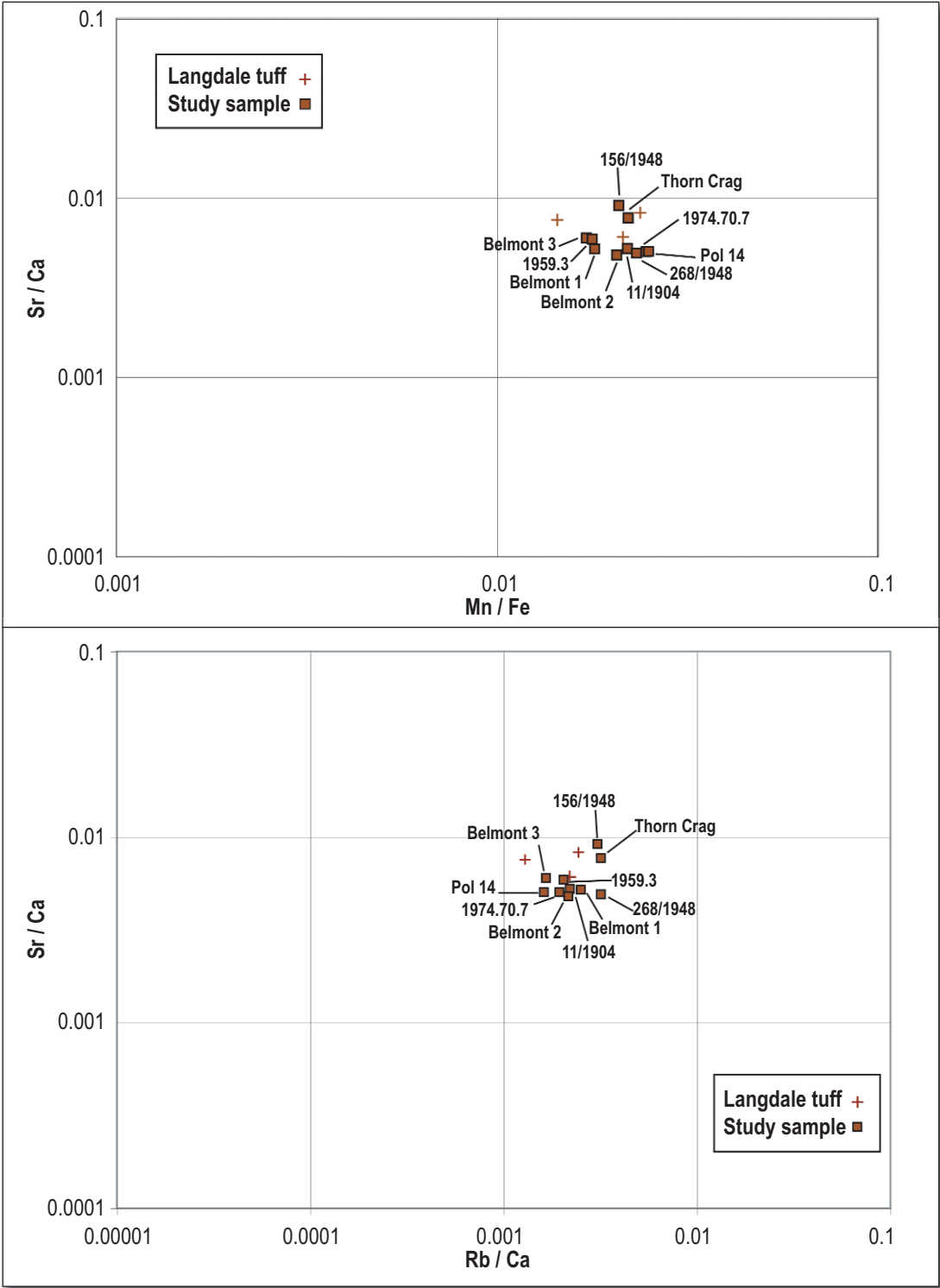


Fig. 12. Geochemical analyses of sample including: the Belmont blades (individually identified); outcrop rock (Langdales 1 and 2); and a sample of roughout and polished *Cumbrian Clubs* from sites across Northern England.

Average compositions for rock samples from Langdale Pike collected by other researchers are also provided for comparison.

Further afield

Undertaken independently, the mapping of roughouts and the petrographic/geochemical characterisation of the Belmont blades reach closely similar conclusions. The weight of evidence suggests that stonework geared towards the making of *Cumbrian* roughouts was concentrated in only part of the outcrop, albeit that area with the greatest densities of material overall. What this patterning reflects is, of course, open to interpretation, but a number of observations can be made.

As already noted, variety in the Seathwaite Fell Tuff formation manifests itself in several ways. Given this, the concentration of activity in such a sharply defined area might indicate that the colour of blades was important. A distinctive hue offered potential as a cue for recognition and for attribution to the source. It may thus have been significant, along with other traits, where blades were carried, displayed or circulated elsewhere. This seems to have been important at sources on either side of the Irish Sea, almost all of which saw investment in the production of blades which could be easily identified for their colour and/or their form (Bradley & Edmonds 1993; Cooney *et al.* 1998). For people at the time, these traits helped to sustain a sense of where particular blades origi-

inated, and the direction they had travelled (Cooney 2002:96). They helped to structure narrative. The significance of colour may have also gone in a very different direction. It may be no coincidence that the quarries for *Cumbrian* blades offered a stone with a distinctive olive green tint which falls within the colour range of blades from the Alps (Petrequin *et al.* this volume; Sheridan this volume). It is difficult to take this very far, but in a world where the form of Jadeite blades was sometimes emulated in other materials (Pailler & Sheridan 2009; Petrequin *et al.* 2008), the use of *Greenstone* may have been evocative of many things.

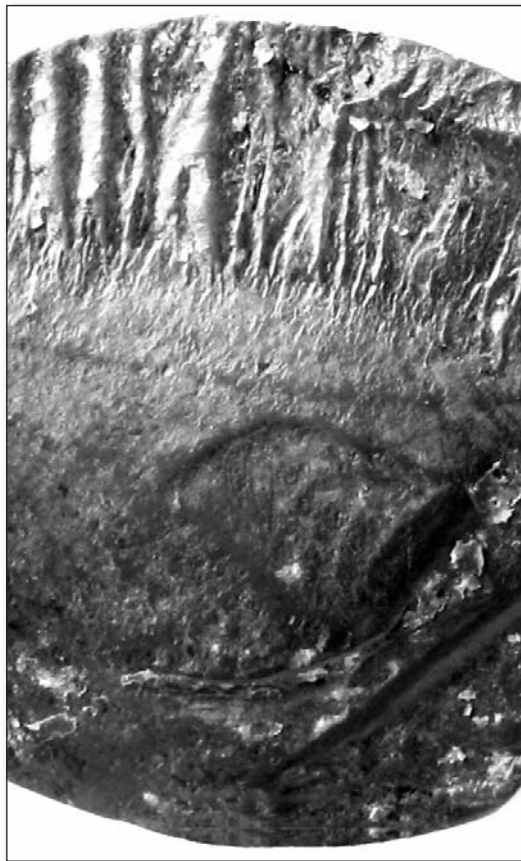
Texture also mattered. Grain size is a useful criteria for classifying Group VI tuffs, especially the extent of layering (bedding), and this would certainly have had a bearing on the conduct of stoneworking. For example, the presence of alternating finer and coarser bedding was abundantly obvious when the joint of the broken Belmont Axe (No 1) was re-broken to gain access to the rock for coring. The fracture showed a coarser grained layer which co-terminated approximately in line with the faceted sides of the axe, sandwiched between two finer grained layers. The two finer grained outer layers may have been easier to flake, and the central coarser layer may have increased the tensile strength of the axe by making it less brittle. This suggests that those working the stone in prehistory were intimately aware of the properties of material at different points along the outcrop and of the influence that layering might have when flaking or grinding specific flakes or blocks.

These qualities were undoubtedly important. Knowledge of material, its character and potential were a prerequisite for the kinds of skilled working that we can trace. Colour too was significant. However, neither of these factors were themselves sufficient to determine that work *had* to be concentrated in these specific areas. Put simply, material with essentially the same properties and hues could also be found elsewhere along the outcrop, in areas with no evidence for the making of *Cumbrian* blades.

Other possibilities can also be considered. For example, there is a close correlation between *Cumbrian* roughouts and those areas where vertical faces were systematically quarried, many of them perched in fairly precarious locations. This raises the possibility that the scramble to exposed and precipitous crags, like the dangers associated with quarrying and fire setting, were integral to the act of drawing roughouts from the stone. This was not a quality confined to the places where *Cumbrian*

Fig. 13.

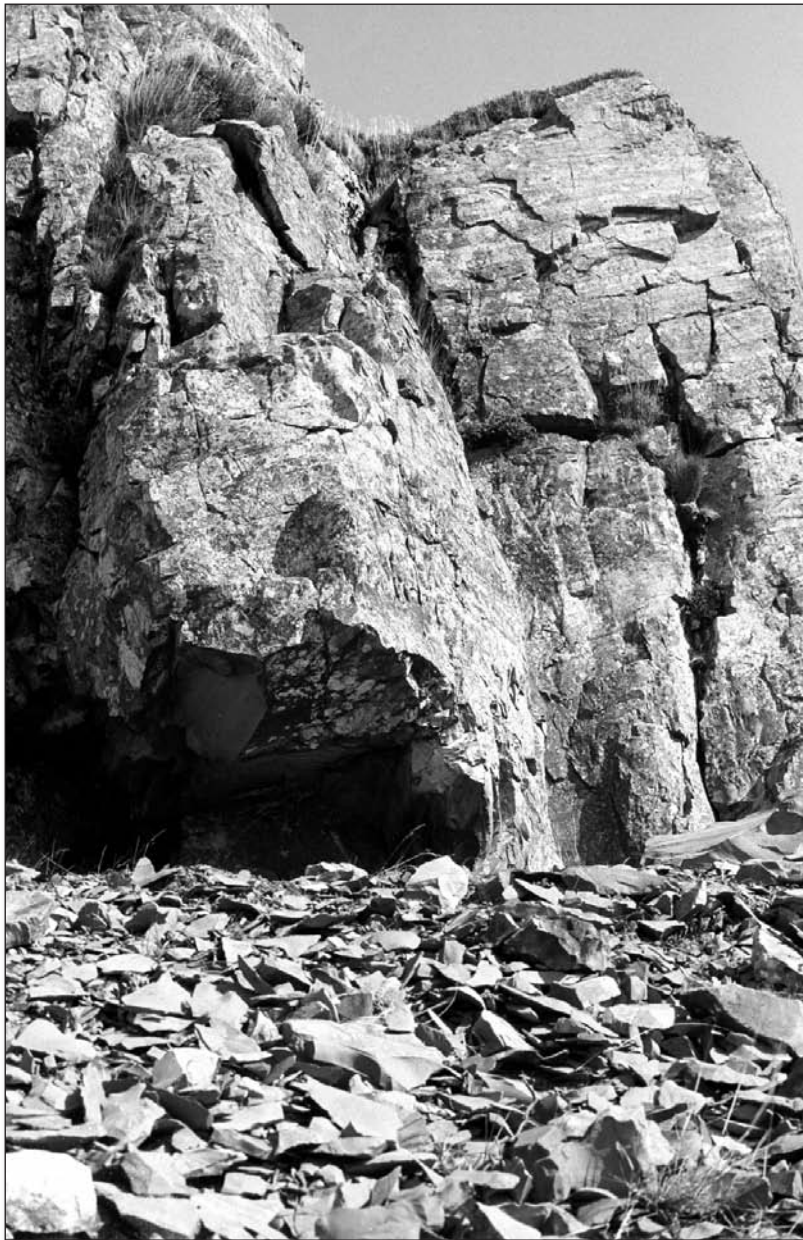
Section of Belmont blade No. 1, showing layering.



blades were made, but it does seem to have been a consistent theme in their making. Where the object and the act had a bearing on identity, the circumstances lent an important drama to proceedings (Edmonds 2004, 2011).

Other clues can be found by broadening the focus. Working in this way and to these ends was confined to part of the outcrop. But it was not concentrated on a singular quarry or more distant working floor. This is particularly interesting given arguments about the broader social landscape within which the sources were set. Access to the stone may have involved a journey, but it was a journey made from several different parts of the region (Bradley & Edmonds 1993). The outcrop was well placed to be approached from several directions, making it a communal monument, a place where

Fig. 14.
Quarry and associated
scree of working debris
above the
Mickleden valley.



paths overlapped. While people probably identified closely with particular parts of the outcrop, access and a sense of belonging to the stone went beyond the horizons of any single family line. Visits probably required contact, agreement and perhaps even cooperation with others, a familiarity with wider webs of relationships (Edmonds 2004). Under these conditions, the distribution of *Cumbrian* roughouts, particularly their presence on paths leading in several directions away from the outcrop, suggests that while there was definitely a time and place for production, it was not something over which a particular group held exclusive sway. Rather, members of several scattered groups may have been implicated, perhaps even recognising a broader sense of affiliation in the process, something else to be carried away when the work was done.

Support for this can be found across the region. The patterns are patchy; recovery has often been accidental, a consequence of agricultural improvement and small scale development such as that which brought the Belmont Hoard to light. Even so, there is enough to suggest that roughouts of all shapes and sizes were brought down to lower ground where more persistent traditions of settlement can be traced. It was in these kinds of settings that grinding and polishing often took place, a pattern reflected in the recovery of stone rubbers and polissoirs as elements within broader surface scatters. This is not surprising. After all, these were parts of the landscape where water was generally ready to hand and where time itself could be made available. These were the same areas in which resources could also be accessed for hafting, a no less skilful activity involving the careful management, selection and working of ash, beech or oak. Nowhere is this clearer than at Ehenside Tarn, where rough-out blades and finished forms, including hafted examples, were found in association with a range of other materials (Darbishire 1873).

Blades born and shaped among the crags were now brought to maturity under the gaze of the community, the connection between individuals and axes made all the stronger by the fact that the work was witnessed. Over many hours, grinding and polishing allowed a sharper definition, established lateral facets and generally enhanced the appearance of the stone. Longitudinal facets traceable on the principal faces of many blades hint at a regular pattern or approach to the process, though the precise mechanics of this are still to be established. What is clear is that the level of finish on many blades was as much if not more about

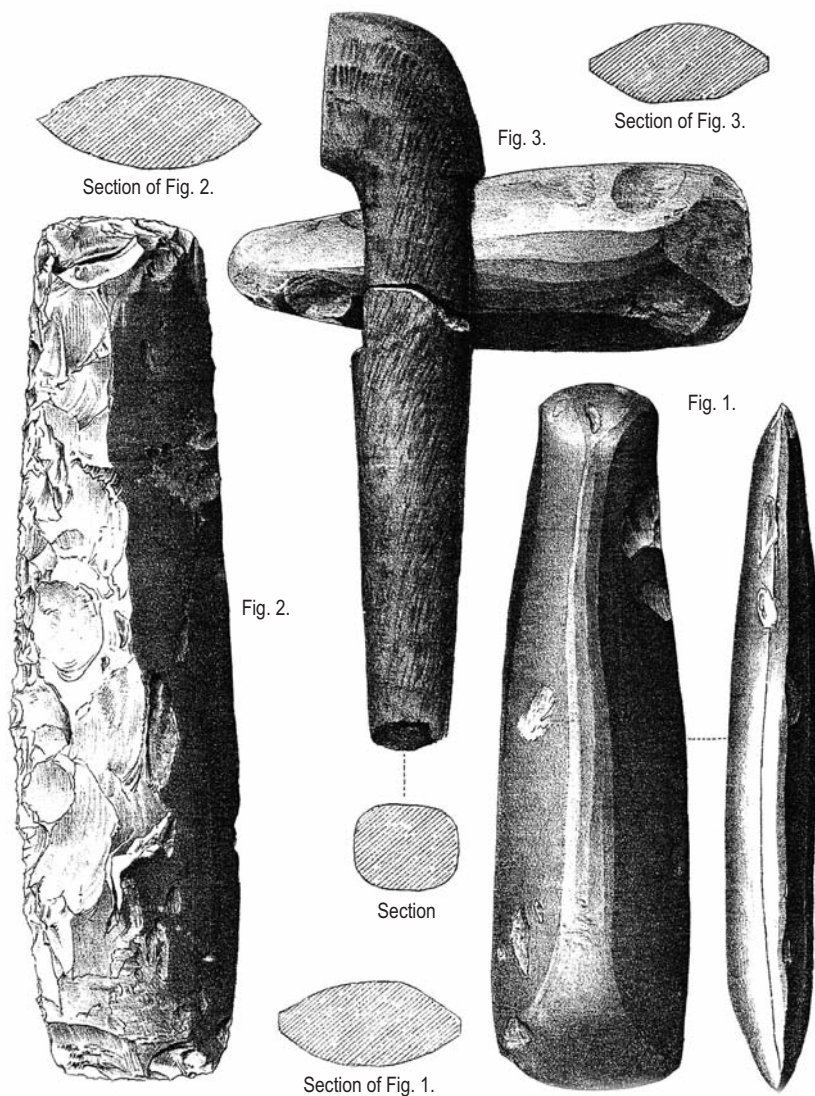


Fig. 15.
Blades and hafts from
Ehenside Tarn
(Darbishire 1873).

Note the longitudinal grinding facets on blades 1 and 3. These occur on many of the larger finished axes found in Cumbria and beyond. Their striking regularity may suggest that grinding involved the use of frames that held the blade in a particular alignment during the process.

aesthetics as it was about utility. Fine grinding and polishing brought out the distinctive colour of the stone. It gave the *skin* of the blade a distinctive lustre and, occasionally, a yet more glassy sheen. These qualities were certainly important and it is probably safe to assume that they were the subject of talk, judgement and comparison. Where blades were more than tools, where they carried people with them, their distinctive characteristics mattered as much as their effectiveness. What they looked like and what they stood for sometimes mattered even more.

Like completely finished *Cumbrian* blades, roughouts with similar characteristics are found *across* the region. Clusters occur in the west and south-west, particularly in those coastal areas where the erosion of sands has led to the exposure of Neolithic and other later prehistoric occupation sites (Evans 2004). Distinctive roughouts have also been identified some distance to the north of the main outcrop and to the east, along the tributaries and course of the

Eden valley. It is perhaps unwise to take these patterns at face value. Historically, the south and west has been an area where opportunities for discovery have been good; a function of the common emphasis on arable cultivation and the extent of raised beaches and related deposits where erosion is commonplace. The situation to the north and east is slightly less favourable, with the effect that the densities in these areas may be under-represented.

Limited though it is, the evidence supports the idea that *Cumbrian* roughouts left the source area in several directions, that they were carried back to more persistently settled country by people drawn from a variety of scattered communities. Finished blades themselves may reflect the same pattern, though here at least, we should allow that their distribution was also shaped by the exchanges that articulated scattered groups. There is no reason to assume that blades only became suitable media for various kinds of gift exchange once they found themselves in Ireland, Scotland, Yorkshire or the Fens. Many certainly made these journeys, passing through different hands and accruing extended biographies in the process. But distance was not the only thing that mattered.

Even *within* Cumbria then, the significance of blades went beyond utility; their categoric and biographical qualities shaping the manner in which many were used and circulated. It was probably these same qualities that directed the inclusion of a number of axes in deliberate hoards. The Belmont blades are evidence enough that this was a practice that involved finished axes, but there are also several containing roughouts (e.g. Annable 1987; Barnes 1963; McIntyre 1937). Most were early finds, for which we have little in the way of context, a good example being the collection of ground and roughout blades from Portinscale (Rawnley 1902). However, what detail there is suggests a variety in the kinds of settings in which blades were deposited; from pits and wet or boggy ground to fissures and gaps in outcropping stone, as at Skelmore Heads, where four flaked blades were deposited in a limestone gryke, close to a possible Neolithic enclosure (Barnes 1963).

As elsewhere, there is no reason to assume that all hoards were necessarily created in the same ways and for the same reasons (Bradley 1990). Where objects carry people with them, changes in the standing or condition of a person might require that the object itself be accorded special treatment. A common context in which this occurs is in funerary rites, where death requires that formal treatment is given





Fig. 16.
Cumbrian axes
(Axe on far left has a
length of c.40cm. All
other axes reproduced to
scale).

Top row l-r:
Great Salkeld,
Langstrath, Keswick.

Bottom row:
Ehenside tarn, Botherby,
Ehenside Tarn, Morton,
Scaleby Moss.

Several of these blades show signs of having been used. The smaller blade from Ehenside tarn bears scars of reworking and has a width that is greatest at the cutting edge. The blade from Morton has a pronounced asymmetry on the cutting edge. This is a common feature and may have been deliberate from the outset. However, it is equally likely to be a consequence of resharpening a damaged blade and the sharp curve may reflect damage incurred through use with a sharp downward stroke.



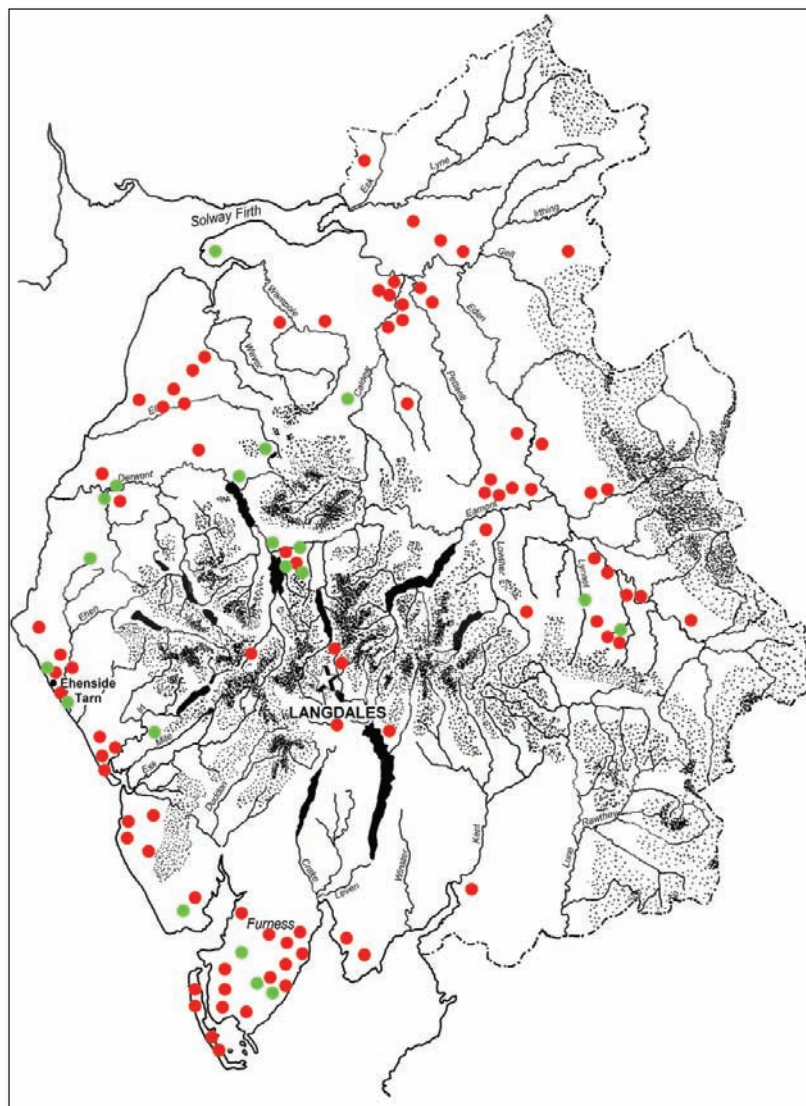


Fig. 17.
Cumbrian roughouts
(green) and finished
blades (red) in Cumbria
(nb, the map excludes
all roughouts found in
the immediate vicinity
of the outcrop).

not only to the body, but also to objects with strong biographical or other connections to the deceased. In other words, items that have lived alongside a person have to be treated in parallel; burnt where a body is burnt, broken up or deposited in an appropriate location. Other motives for hoarding include the making of gifts to gods or local spirits. These can be acts which pay respects or ask for intervention, or even more ostentatious bouts of sacred gift giving, which have the effect of enhancing the standing of the giver. There is certainly a wealth of evidence on the continent to suggest that blades were often an appropriate element for inclusion in hoards at this time, particularly those which had traveled some distance before they were placed in bogs or rivers (Larsson, this volume; Wentink 2006, 2008), and it may be that similar ideas are useful here. Whatever its immediate context, the deposition of the Belmont Hoard would have been a powerful gift, whoever the recipient was. Whether this

applies equally to finished blades and roughouts remains to be seen. It is unlikely that all roughouts had to be ground and polished the moment they were brought down from the source. Some were probably cached out of the way, kept 'fresh' in the moist earth or back within stone. Others were probably propped against the side of a lodge for grinding when the need arose; when an existing blade broke beyond repair, or when several were needed for marriage payments, the settlement of debts or for more ceremonial prestations. There is little here of which we can be certain. While some hoards were deliberate deposits, we should allow that not all of these were necessarily that final.

Problems and potentials

It is difficult to take the evidence from the region very much further. In an area defined by large tracts of upland grazing, where lowland development is often on a limited scale, chance finds remain one of the most common forms of evidence. That said, commercial archaeology and ongoing research are beginning to have an impact, raising the possibility that we may soon be able to say far more about the broader landscape context in which the sources were set, and the specific conditions in which blades were finished, used, circulated and deposited across the region. For this to happen, several major problems remain to be addressed. The first of these is chronology. At present, the C^{14} dates we have indicate that work up at the source was probably underway around the beginning of the fourth millennium, and continued for well over a thousand years, perhaps significantly more (Bradley & Edmonds 1993; Quatermaine *Pers Comm*). Though useful, these dates are so few and far between that they do not as yet allow any sharp refinement in our understanding of how different areas of the source were used over time. The same applies across the region, where absolute dates associated with axes are also rare. What there is suggests that the making of Cumbrian blades was certainly a feature of the first half of the fourth millennium, but here again, we know very little about the duration of this tradition, nor whether this varied from one side of the Fells to the other. Further refinement on both these scales is a major priority.

A second major problem is also a potential. For some time now, debate amongst petrologists has revolved around the extent to which particular petrological groups can be defined



with confidence. Group VI is a good case in point; it has long been accepted that some blades made from the Seathwaite Fell Tuff formation fit the characterisation of the Group better than others. This has now been compounded by the fact that other Groups (e.g. XI) outcrop within the same geographic area and as survey continues, it is likely that this complexity will increase (Davis & Quatermaine 2007). As the limited work reported here suggests, the advent of new geochemical methods offers the prospect of being able to add a significant depth to our picture (Sheridan, this volume). What is now needed is a comprehensive and more detailed characterisation of both source and products. In time, this will allow us to link many individual blades with specific points along the outcrop and with different areas across the region and beyond. For this to have its full effect, such work should ideally go hand in hand with the detailed morphological characterisation of blades on a national scale. The dividends of such an integrated approach have been more than amply demonstrated elsewhere (Cooney *et al.* 1998; Petrequin *et al.* this volume).

The problems we face are no less acute when we consider the broader landscape context in which blades have been identified across the region. The link between the finishing of blades and areas of occupation is certainly valid. But it is heavily skewed towards areas such as the coast, where the rapid erosion of raised beaches and associated deposits have proved favourable for the recovery of surface assemblages (Evans 2004). Even here, we do not as yet know enough about the very specific circumstances in which blades were finished, a problem that is even more acute elsewhere in the region. Once again, ongoing research in areas like the Eden Valley offers the potential to bring radical changes to our picture, but it will need work at several scales to add the kind of detail that is needed.

Other kinds of site also wait to be explored. Our evidence may be consistent with models of essentially small and scattered settlements. But there were also places above and beyond the everyday. The outcrop itself was one of these; a place that drew people up, it possessed many of the qualities of a monument. However, it was probably not the only one. Survey suggests that Cumbria saw the development a number of large and distinctive enclosures, which survive today as soil marks, stone banks or earthworks. The majority may well be Neolithic in date (Oswald *et al.* 2001) and potentially earlier than the stone circles and

henges for which the region is well known (Barnatt 1989; Burl 1976; Clare 2007). At *Carrock Fell* for example, morphology and setting suggest that a large stone built enclosure originally classified as Iron Age may have significantly older foundations (RCHME 1996a). Interestingly, an outcrop of stone that saw use for blade production, identified as Group XXXIV, has been located close by, raising the possibility of a link with the enclosure itself (Davis *et al.* 2009). A similar argument for an early date has been made for *Howe Robin* on the eastern limestone and for *Skelmore Heads* on the Furness Peninsula (RCHME 1996b, 1996c; Evans 2004), while *Green How*, on Aughtertree Fell possesses an interrupted bank and ditch very reminiscent of earlier Neolithic enclosures seen further to the south (Oswald *et al.* 2001). A rather different situation can be seen at *Long Meg and her Daughters*, where aerial survey has demonstrated the existence of a ditched enclosure far larger and apparently earlier than the well known stone circle (Soffe & Clare 1988). The characteristics and settings of these enclosures are enough to suggest a longer and more complex history of collective monuments in Neolithic Cumbria than has hitherto been recognised. But this needs testing in the field, and it will only be through fieldwork that we will establish the nature of these sites and the relation they had to the finishing, circulation and deposition of blades.

We began this paper with the rediscovery of three blades, and a sketch of their life history between 1867 and the present. Papers elsewhere in this volume make it clear that this is by no means an unusual case. They also show that the life histories of many axes were no less complex in prehistory. In tracing the conditions in which *Cumbrian* blades were made, we have established a few of the outlines of what this involved and what it meant to people at the time, but there is clearly a great deal more to be done. What we offer here is a step towards that end.



Acknowledgements

The authors are greatly indebted to Rob Ixer, Peter Webb and John Watson for their work on the petrography and geochemistry of the Belmont Hoard. We would also like to acknowledge the provision of a research grant towards the cost of the fieldwork, petrographic and geochemical analyses, which was generously provided by the *Cumberland and Westmorland Antiquarian and Archaeological Society*.

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- ■ ■ Originally acquired by Charles Monkman, this Neolithic flaked flint axe from Denmark was one of many that flowed into private and public collections during the later 19th century. Such pieces had many attractions. They were both plentiful and easy to obtain, particularly by those well placed in antiquarian/ archaeological networks of exchange. Many were also complete, a prerequisite for pieces that were destined for display. More important still, blades such as these were pivotal in some of the first systematic attempts to link artefacts and chronology in the definition of prehistory. As such, they carried academic weight, reflecting well upon the connections, learning and esteem of their owners. And when those owners died, that esteem could sometimes live on, names sustained for posterity in the material bequeathed to learned philosophical societies and municipal museums. ■

●●● *It was the year after we'd finished digging. One of our volunteers, G, turned up to a talk and afterwards, over coffee, produced a stone from his pocket. It was a hand-sized quartzite cobble, smoothed from years in a river. But it had also been ground down to create a distinctive cutting edge. I asked him where he'd found it and he looked embarrassed: on site last year, B said it was nothing and to toss it, but I couldn't bring myself to let it go. It's in the archive now. ●*

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The prehistoric axe factory at Sanganakallu-Kupgal (Bellary District), southern India

Abstract

A 10–30 m wide dolerite dyke on the northernmost of the complex of granite hills in the Sanganakallu-Kupgal area became one of the main sources of raw material for the production of stone axes in southern India during the late prehistoric period. At least three large hill settlements (several hectares each) were established in the hill complex, and one of them appears to have gradually developed into a large scale production centre. Quarrying and axe flaking started around 1900 cal BCE, during the so-called Ash-mound period, and reached its maximum development between 1400–1200 cal BCE, when a large region of the south Deccan plateau might have been supplied with finished and half-finished products from Sanganakallu.

Systematic archaeological excavation and survey carried out since 1997 in the Sanganakallu-Kupgal area, including the dyke quarry itself, has yielded tens of thousands of production flakes, blanks and macro-lithic tools related to the flaking, pecking and polishing of the axes. The ongoing study of these materials permits us to gain insight into the organisation of production in this area from a temporal and spatial perspective.

In view of the social and economic transformations taking place in the Deccan during the second half of the 2nd millennium BC, some key questions concern the relationship between intensification of production and the social division of labour between different working areas and settlements.

Geographical, geological and archaeological context

During the last five years, intensive research has been conducted in what appears to be one of the main prehistoric axe production centres of southern India (Boivin *et al.* 2005, 2007; Brumm *et al.* 2006, 2007; Fuller *et al.* 2007). The Sanganakallu-Kupgal archaeological complex, which includes several settlements, ash-mounds, quarry sites and other activity areas, is located 6 km east of the modern town of Bellary, in the centre of the Deccan plateau. This region is characterised by semiarid environmental conditions in the monsoon climatic belt, and such conditions were established by the third millennium BC (Fuller & Korisettar 2004). The region came to the notice of Western scholars at the end of the 19th century, due to the occurrence of extreme famine under the Victorian occupation, which led to the starvation of 11 million persons (Davis 2001). This very dry region is at the heart of the earliest known Neolithic cultural sphere in peninsular India, where ceramics and ground stone tools are reported from as early as 3000 BC (Korisettar *et al.* 2001a), and archaeobotanical evidence indicates cultivation of indigenous food plants alongside herding of introduced

Fig. 1.
The three hills of the Sanganakallu-Kupgal complex. In the foreground is Hiregudda, taken from Area C, where quarrying of the upper reaches of the dolerite dyke was carried out, and looking down onto Area A, where stone tool manufacture was carried out. The hill being heavily quarried today for granite is Choudammagudda. Sannarachammagudda can be seen beyond it. The modern village of Sanganakallu is visible in the upper left, while the town of Bellary can be seen off in the middle distance.
(Photograph by J.A. Soldevilla).

livestock during the third millennium BC (Korisettar *et al.* 2001b; Fuller *et al.* 2004). The Neolithic culture in this area is characterized by distinctive ash-mound sites, which feature thick accumulations of ash thought to derive from the burning of dung at seasonal cattle-penning sites, perhaps as part of ritual cycles (Allchin 1963; Korisettar *et al.* 2001a; Boivin 2004a; Johansen 2004).

The geological record in the Bellary district is mainly Pre-Cambrian in age and the rocks can be divided broadly into three types: a) the gneisses and granites belonging to the Peninsular Gneissic Complex (PGC), which are the oldest rocks and constitute the basement, b) the schistose rocks of Dharwarian age comprise both sedimentary and volcanic low-grade metamorphic rocks and c) the younger Closepet Granite, which shows an intrusive relationship with both previous formations. In addition, different basic dykes of gabbro and dolerite rocks from Proterozoic age were probably emplaced following deep fractures in the PGC and Closepet granite during the first steps of deformation, recorded in the schists as anticline and syncline fold structures.

From a geological perspective, the Sanganakallu area is situated in the younger Archaean granitic formation (Dharwar batholith). The



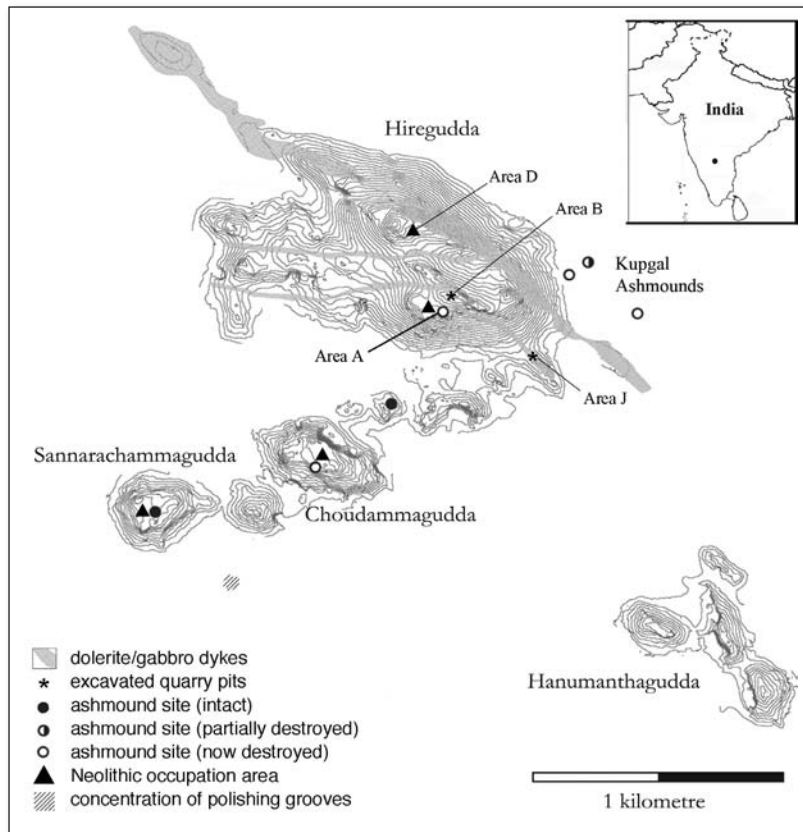


Fig. 2.
Map of the Sanganakallu-Kupgal archaeological complex. The grey shading indicates the location of the dolerite dykes on Hiregudda, which total 4 in number. The quarried dyke runs from area J in the southeast to Area B in the northwest.

granitic bedrock emerges as inselberg in the ancient floodplain. Frequent quartz and pegmatite veins and basic dykes of post-Archaean formation transverse these granites, mainly in a northwest-southeast to west-east direction. The size and composition of these dykes is highly variable. One of the dykes, which crosses part of the Hiregudda inselberg (the largest hill in the Sanganakallu-Kupgal complex), 1.5 km northeast of the modern village of Sanganakallu, was the focus of intensive prehistoric quarrying and axe blank production. The dolerite outcrop is about 700 m long and varies between approximately 10–30 m wide. Masses of manufacturing debris cover its surface over at least 500 m of its course, practically from the plain at the southeastern foot of Hiregudda (450 m a.s.l.), continuing in northwest direction uphill to a height of 560 m a.s.l. Three other dykes also traverse Hiregudda, but do not appear to have been quarried (see Fig. 2).

The first notice of the exceptional quarry area at Hiregudda dates back to the observations of the British geologist Robert Bruce Foote at the end of the 19th century (Foote 1887, 1916), with subsequent explorations in the mid-twentieth century (Subbarao 1948; see Korisettar *et al.* 2001a). Foote referred to it as “the most important neolithic settlement in the country” (1916: 82), and “the site of the largest neolithic manufacturing industry as yet met with in any part

of India” (ibid:82). Recent work continues to illustrate its importance. Nonetheless, little research was carried out at Hiregudda subsequent to Foote’s explorations, in part because the neighbouring site of Sannarachammagudda became a focus of investigation (Ansari & Rao 1969; Subbarao 1947, 1948). Renewed work was thus initiated at the site in 1997. Test excavations and sampling aimed at chronological placement and reconstructing subsistence were carried out in 1998 in Hiregudda Area A (Korisettar *et al.* 2001b; Fuller *et al.* 2004). Larger scale systematic excavation and mapping was carried out between 2003 and 2006 when several trial trenches were excavated in the upper and the lower parts of the dyke, named Hiregudda Area B and Area J respectively (Boivin *et al.* 2005). More than 95% of the material recovered from the resultant trenches consisted of dolerite shatter and waste flakes. Axe blanks, hammer stones and a few horn tools also inform about the activities carried at these quarries, as discussed below.

Close to the quarry, on the natural terraces extending across the top of Hiregudda, at least three settlement areas of c. 0.5–1 ha in size and one ash-mound were located. Excavations carried out in two of these areas (Areas A and D), one of which included the ash-mound, confirm that these habitation and activity areas were to a large extent contemporary to the quarry (Boivin *et al.* 2005; Fuller *et al.* 2007).

Two additional settlements greater than 1 ha in size were identified on the granitic hills called Choudammagudda and Sannarachammagudda, located 700 m and 1400 m southwest of quarry, and also part of the Sanganakallu-Kupgal complex. While the first has only been investigated as part of one recent field season, Sannarachammagudda and its ash-mound have been the target of archaeological research since the 1940s and represent one of the key stratigraphies for the later prehistory of southern India (Subbarao 1948; Ansari & Nagaraja 1969; Korisettar *et al.* 2001b; Fuller *et al.* 2007). On both sites, the presence of axe blanks, dolerite debitage and different percussion and polishing tools leave little doubt that the inhabitants of both settlements were involved in axe production.

At this point in time, no radiocarbon dates are available for the quarry areas, but the dating programme carried out at the habitation sites of Hiregudda and Sannarachammagudda provides ages that indicate occupation at the beginning of the Neolithic, at around 1950 cal BCE (Fuller *et al.* 2007). Although axe manufacture formed part of the local economy from

the beginning, the intensity of production experienced important variations over the centuries. After c. 1100/1000 cal BCE the settlements were apparently abandoned, and evidence from later occupations is scarce. The excellent preservation of the archaeological record, and the quantity and variety of means of production present on the settlement and quarry areas makes the Sanganakallu archaeological complex attractive for the study of social and economic organisation and prehistoric axe production.

The petrographic composition of the Hiregudda Sanganakallu dolerite dyke

One of the main questions that arise in view of the scale of quarrying and axe production at Hiregudda concerns the material properties of the dolerite dyke targeted by prehistoric people. As already mentioned, this type of basic dyke is a common geological feature of southern India, but at this particular locality, evidence of large scale prehistoric exploitation is observable. It appears to have been a particular focus of axe production. While petrographic characterisation is necessary in order to define the distribution network of the Sanganakallu artefacts, it is possible that they were exchanged or traded over large parts of southern and central India.

Field survey enabled us to observe that marked differences exist between the quarried dolerite outcrop at Hiregudda and another dyke just 180–200 m further north that also traverses the hill. This latter much wider and larger outcrop, which runs parallel to the quarried dyke, and extends along the top of Hiregudda, was a local focus of rock petroglyphs (Boivin 2004b; Fawcett 1892). One can imagine that the dark colour of this chain, formed by large boulders running through a light granite hill, was perceived to be of particular symbolic importance. The rock can best be defined as a coarse-grained, extremely hard gabbro. It was used as raw material for percussion and abrasive tools on all three hill settlements, as well as in the quarry.

Rock samples were taken from both dykes as well as from archaeological materials and submitted to petrographic analysis through thin sectioning (Fig. 3). The two identified rock types can be characterised as follows:

- * The dolerite is a microcrystalline gabbro showing an intergranular texture formed by augite crystals occupying the spaces between plagioclase laths.

- * The gabbro consists of a fine to medium-grained holocrystalline rock with intergranular texture. The rock mainly contains crystals of plagioclase, augite and biotite but some accessory quartz crystals with granophyric texture can be observed.

The textural arrangement of the crystals forms a 3D holocrystalline isotropic framework in both rocks and confers high mechanical strength. Moreover, the microcrystalline grain size of the dolerite allows a concoidal fracture, one of the necessary conditions for flaked axe production.

Experimental tests were carried out in order to gain a better understanding of the material properties of the rock and its behaviour during the knapping, pecking and polishing stages, as these represent the documented techniques used in Hiregudda axe production. Flaking of natural blocks and slabs confirmed the concoidal fracture habit of the material when submitted to heavy impacts. Pecking and polishing tests proved the extreme hardness of the dolerite. Here, it is worth mentioning that part of the experiments were carried out by local male villagers, whose usual income derives from the manual quarrying of the granite and who are familiar with the mechanical properties and working of stone. Axe blanks collected from areas disturbed by modern quarrying were ground on granite bedrock with the addition of water and sand, which had previously been prepared by crushing the same granite. Without the addition of this abrasive material, the grinding process proved practically impossible and required considerably more strength. Every 30 minutes, the axe blank was cleaned, documented and weighed. Soon it became evident that most grinding efforts had to be carried out on the thickest part below the edge, confirming the importance of a competent prior flaking strategy. The mean material loss, or *abrasion wear index*, was hardly 3 gr. of dolerite an hour. The grinding of afanitic rocks from the axe factory of Plancher-les-Mines (Vosges) on sandstone slabs resulted in wear indices between 5–13 gr/hour (Petrequin & Jeunesse 1995:41). Given the hardness of the Sanganakallu dolerite the grinding of a reasonably well-prepared blank into a usable edged tool of 9–10 cm length would likely have required around 6 hours of work. Much more effort would be necessary in order to obtain a completely polished axe.

Fig. 3.

Thin sections of the gabbro from the Northern dyke and dolerite from the Southern dyke (axe quarry) of Hiregudda (Photographs by David Gómez-Gras).

A:

general view of the intergranular texture of the gabbro rock containing crystals of augite (green) and plagioclase (light) under plane polarized light (PPL) and

B:

under crossed polars (PPX).

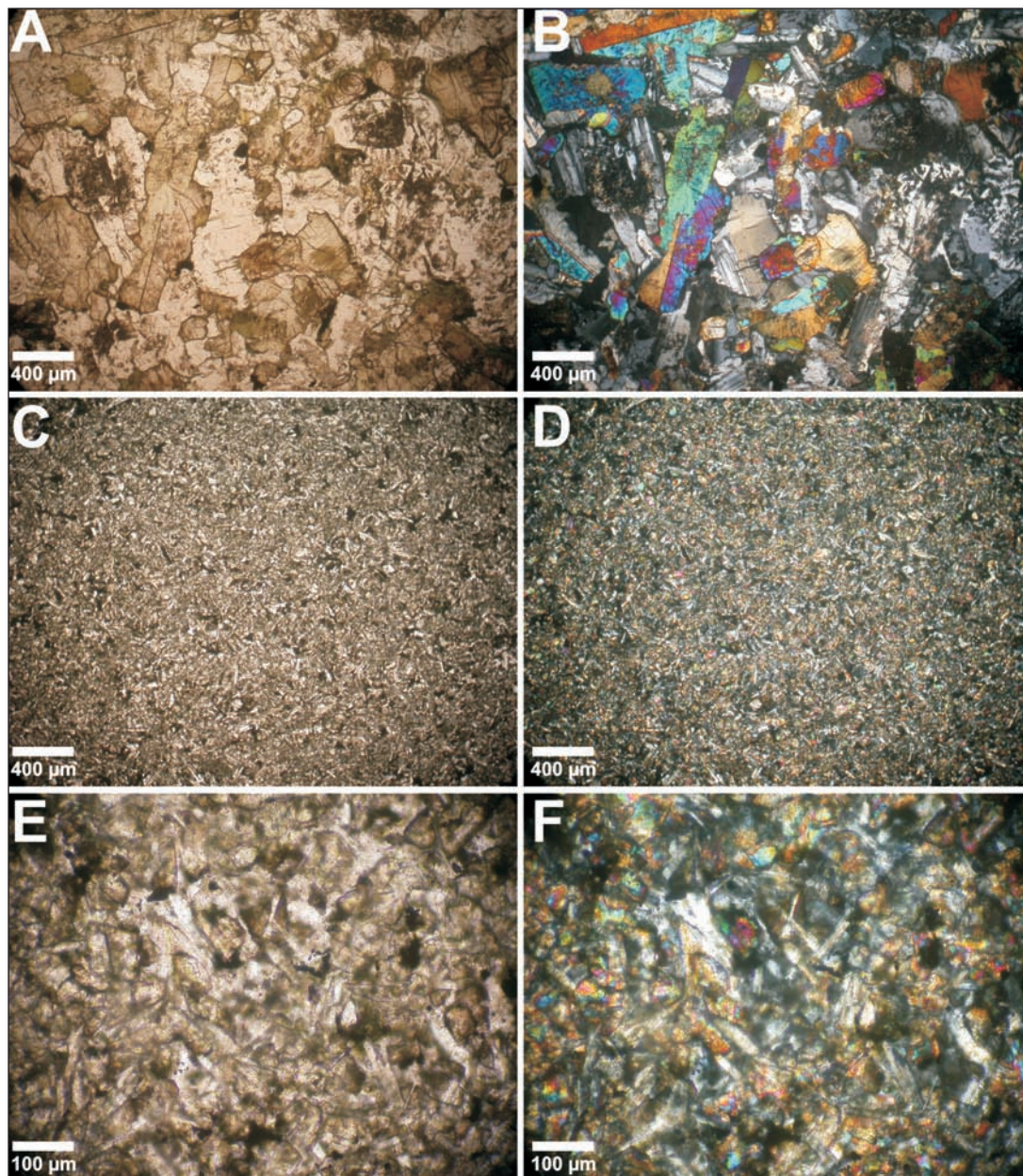
C (PPL) and D (PPX):

images of the microcrystalline intergranular texture in dolerite rock.

E (PPL) and F (PPX):

enhanced images showing augite crystals (red, blue and orange colours) occupying the spaces between plagioclase laths (grey).





Technical organisation of production

The excavation and surface surveying of the quarry area and the three hill settlements has provided abundant information on the axe production process and its organisation. The test trenches placed in the upper and lower parts of the dolerite outcrop show that the quarrying took advantage of the intense fracturation of the deposit by systematic joints. This enabled the extraction of small blocks or slabs with relatively little effort, and clearly represents an important economic advantage in comparison to the other dykes.¹ Percussion stones of dolerite, gabbro and granite, as well as chisels of antelope horn, found within the quarry debris, were used to break up the deposit. A

spherical hammerstone, weighing 1767 gr., made out of gabbro from the northern dyke, is the heaviest artefact of this type recorded so far at Sanganakallu.

The main operation involved obtaining 15–30 cm long blocks, slabs or nodules of angular, sub-angular or sub-rounded shape. Their outer surface has a yellow-orange colour resulting from oxidation of the rock minerals by weathering processes in the systematic joints. This surface alteration has proved to be a helpful trait in reconstructing how the natural slabs were worked. Traces of this “skin” remain to a greater or lesser extent on c. 50% of the unfinished products as well as on some used axes. In 8% of the blanks, surface alteration appears on the dorsal as well as ventral sides of the blank, indicating the thinness of some of the selected slabs.





Fig. 4.

Stages in axe production:

- 1:
natural dolerite block;
- 2:
initial flaking of lateral
edges of the block;
- 3:
flaked blank;
- 4:
blank with slight
pecking traces;
- 5:
blank with more
intensive pecking,
- 6:
polished axe.

(note different scales;
photography by José
Antonio Soldevilla).

In general, three reduction strategies have been identified in the Sanganakallu lithic assemblage. The methods are defined mostly on the basis of the initial dolerite stone packages utilized (Brumm *et al.* 2007). These include:

- 1) large symmetrical sub-rectangular stone blocks and thick slabs;
- 2) thin flat cortical slabs;
- 3) flake blanks and non-flake debitage of varying shapes and sizes.

In all cases, the dominant procedure was to work the blocks, slabs or flakes bifacially around the perimeter of the stone piece (Fig. 4). Yet, considerable variation in the knapping procedures can be observed within all three trajectories, suggesting that persons with very different skills and habits were operating simultaneously in the area.

The main target that needs to be achieved in the knapping process is the reduction in thickness of the rough-outs, as thinner axe blanks will require less pecking and grinding. Unskilful knapping is visible in the form of thick blanks which had no further modification. These resulted in discard in the quarry and settlement areas. On occasion, these thick blanks were transformed into percussion tools. It is much easier and quicker to dress thin slabs or flakes (methods 2 and 3) than working larger blocks and slabs, which requires a higher level of tech-

nical control (method 1) (Brumm *et al.* 2007). In this case, the rocks were reduced on one face through lateral flaking, while knapping on the opposite face was much less invasive, thus taking advantage of at least one of the flat surfaces of the slabs or blocks. Again, the underlying principle seems to be to spare effort and time during the knapping, as well as during the later pecking and grinding stages.

One possible way of determining the technical competence or variation of knapping is to consider the relation between the length and the weight of the blanks and finished axes. High technical control results in thin artefacts, which require shorter polishing processes and/or provide sharper edges. Depending on the type of natural rocks used, it also enables the maximisation of raw materials. Low flaking skills produce thick and, consequently, heavier artefacts. Therefore, the relation between length and weight provides a useful analytical test to evaluate the degree of skill manifest in the flaking process.² If we correlate these two variables measured on a sample of artefacts from the Sanganakallu axe collection, it can be observed that variation in production is high (Fig. 5). On average, unskilled examples are 2.8 times heavier than the well-flaked blanks of the same size. For example, the weight of a typical 10 cm long axe varies between 100 and 240 gr. As expected, most of the finished and used axes fall among the lighter examples. It seems reasonable to

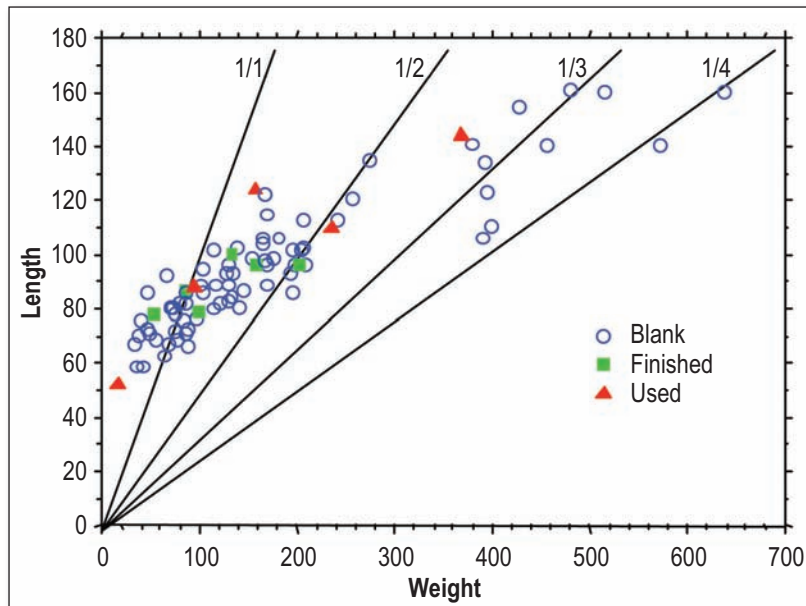


Fig. 5. Relation between length and weight of axe blanks, finished axes and finished axes with signs of use wear from Hiregudda (Area A and J) and Sannarachammagudda (Trench 10). Lines mark the relation between length and weight and are therefore indicative of higher (1/1) or lower (1/4) technical competence.

assume that many of the artefacts found during survey and excavation were in fact discarded because of the low quality knapping and the work load their finishing would have created. The technical organisation of production was not very rigid and persons with different levels of skill seem to have been at work simultaneously.

About 25–30% of a test sample of finished axes and blanks from Hiregudda and Sannarachammagudda showed traces of pecking, visible as small pits (Fig. 4). This process seems to have been carried out with the same type of dolerite, gabbro, quartz and granite percussion stones as flaking, and mainly served to reduce the highest points and crests of the preforms. The pecking traces rarely cover more than 20% of the surfaces. It appears that this working stage was only applied occasionally, in order to

reduce irregularities or blank thickness resulting from knapping errors.

The final stage of stone axe production consists of grinding and, eventually, polishing. As in the case of pecking, this labour intensive process rarely affects the whole surface of the artefact, leaving traces of earlier work stages and even parts of the surface skin of the raw material (see also Allchin 1957). In many cases only the cutting edge is polished. Again, the technical organisation of the production process seems to have been guided by utilitarian and quantitative criteria, rather than by the finishing and aesthetic aspect of the products. As indicated below, it is possible that a considerable portion of the blanks or pre-forms were not ground in the Sanganakallu area, but in settlements further away. It is likely that only some of the artefacts were polished locally (see also Boivin *et al.* 2005:77).

One of the longest known archaeological features of the three hill-settlements are the grinding or polishing grooves and hollows found in the granitic bedrock or on large boulders across much of their surface (Subbarao 1948; Boivin *et al.* 2007). Use wear analysis, as developed for the study of macro-lithic artefacts (Adams 2002; Risch 2002), has been carried out on the working surfaces of these features, in order to confirm their participation in the axe grinding process. This is the first such analysis of the features, and indeed of any grinding hollows in India. The mesoscopic observation (5–20X) of the working surfaces has shown that not all of these features served the same purpose and that many were used for different tasks. Mainly the smaller and oval hollows or ‘slicks’ present evidence of intensive abrasion and use wear traces related to the grinding of



Fig. 6. Polishing hollows from Choudammagudda at an initial, middle and final stage of development (Photograph by J.A. Soldevilla).

stone (Fig. 6). The larger rounded hollows in contrast show traces related preferentially to grain processing. Experimental tests confirmed that the deeper oval features allow a nearly mechanical grinding of the blank's edges by placing the whole artefact in the hollow, pressing it with the flat hand and carrying out a rocking movement with it. Such an operation is much more comfortable than holding the blank in the hand and grinding only the frontal cutting edge against the rock surface. In fact, many artefacts show polishing traces around the periphery, especially on the bevelled edge and the opposite butt, while the flat surfaces of the dorsal and ventral faces remain largely unchanged due to a lack of contact with the convex grinding hollows.

A different form of grinding must have been carried out in the V-shaped polishing grooves, which are much less frequent in the settlements. Such features are known from ethnographic and experimental examples and allow the polishing of lateral edges (e.g. Kennedy 1962; Delage 2004:40). In addition to the highly levelled grain surfaces, the intensity of the activity carried out in these grooves and the hardness of the worked material is also revealed by scratches and deep striations on the groove surfaces.

Socio-economic organisation

The excavation and survey campaigns carried out between 1997 and 2006 on all three settled inselbergs around the dolerite quarry have provided information about the social and economic organisation of axe production in the Sanganakallu area. Though the archaeological record of the area is still undergoing study, these findings offer some insights into the social relations of production of the 2nd millennium BCE. One of the central issues concerns the nature of social access to critical natural resources and the organisation of the different production stages among the population, as well as the possible emergence of relations of social and political dependency.

The lithic material recovered along the dolerite outcrop corresponds to the quarrying activity itself, as well as to a massive amount of flaking of bifacial axe blanks. Large amounts of reduction flakes and discarded axe blanks cover the southeastern slope of Hiregudda. As one moves up the dyke, other stone artefacts, such as hand stones and grinding slabs for cereal processing, as well as pottery begin to appear. This shows that the dolerite outcrop lay in close



Fig. 7.
Circular structure
(Feature 1) in
Hiregudda-Area A
(Photograph by
P. Whittaker).

proximity to settlement areas expanding on the hill of Hiregudda, and seems to have overlapped with them. Hence, quarrying activity was not taking place in a separated and exclusive territory, as was the case at Great Langdale or other European extraction sites (Bradley & Edmonds 1993; Petrequin & Jeunesse 1995; Le Roux 2002; Petrequin 2006), but rather formed part of a more or less loosely settled territory. It still needs to be clarified if the occupation next to the quarry was a permanent form of settlement, or rather some form of temporary, seasonal arrangement. In any case, the central and southeastern part of the Hiregudda plateau, 80–120 m away from the dyke, shows evidence of a rather stable form of occupation.

Intensive survey and excavations have been carried out at the upper end of the dolerite dyke, in Area A of Hiregudda. In addition to a partly destroyed ash-mound, this site presents the most outstanding accumulations of dolerite debitage of any of the Sanganakallu settlements. Of particular interest is a round structure of 7 m in diameter and visible on the surface, named Feature 1, which was fully excavated (Fig. 7). The use of this structure dates between 1700 and 1250 cal BCE, with a possible hiatus between 1500–1400 BCE (Fuller *et al.* 2007). While stone artefact production debris is found throughout the structure's sequence, the lithic-rich upper deposits inside and around this building, containing hundreds of thousands of flakes from axe manufacturing, accumulated to a large extent between c. 1500/1400 and 1250 cal BCE. The volume and type of flakes strongly supports the idea that this stone-lined circular structure functioned as a specialized lithic production 'workshop' for the manufacture of axes and other dolerite implements, such as chisels. The long, narrow and more or less cylindrical pre-form of these latter artefacts requires a particularly skilful knapping technique, which seems to have been exclusive to Area A and particularly to Feature 1.



While the manufacture of dolerite axes was the dominant activity over at least the last 150 years of Feature 1's occupation, it is equally clear that other activities also took place within this building. Apart from dozens of dolerite, gabbro, quartz and hematite hammerstones and a large stone slab with polishing grooves linked to axe production, the structure's users disposed of cereal processing tools (handstones and querns), polishing artefacts and even one pottery burnisher. Finished axes and chisels suggest that wood working could have been carried out as well. A further activity was the repairing and resharpening of such edge tools, as can be inferred from the presence of flake and non-flake debitage bearing ground facets as well as some reworked axes (Brumm *et al.* 2007).

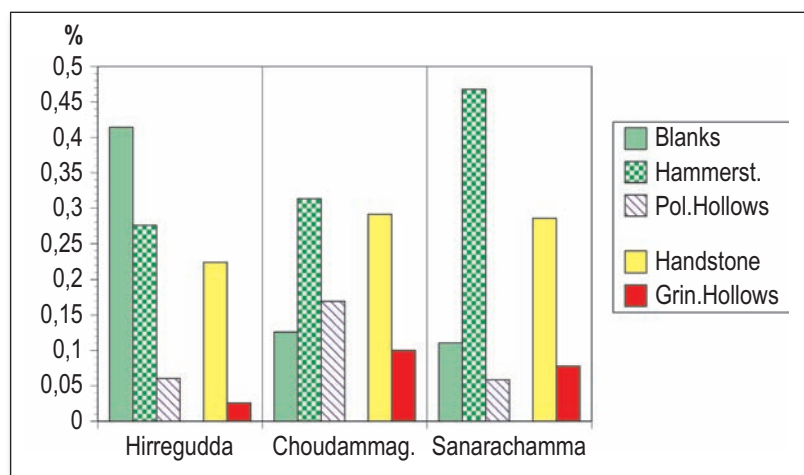
The spatial distribution of the artefacts and debris within Feature 1 shows a clear pattern, and the structure appears to have been entered from the south. According to the distribution of debitage, axe production seems to have been 3.3 times more intense in the western than in the eastern half of the room. A large immobile granite quern placed in the southeast corner seems to have been transformed during the final occupation into an axe grinding surface, which may indicate the greater importance of axe production activities during the last centuries of the occupation. Pottery and ash are more frequent in the northeastern corner, suggesting that this was an area for food preparation and consumption. Outside the dwelling, large amounts of knapping debris accumulated, and seem to have resulted from periodic cleaning of its inner space. The presence of 16 grinding grooves on granite boulders recorded in Hiregudda, absent or rare on the other hill settlements, confirms that the specialised edge grinding and finishing of axes and chisels represented another important and time consuming activity in Area A. Clearly, the inhabitants of other more 'domestic' structures and dwellings identified in the vicinity were participating in these tasks and maintained a close relation with the production processes taking place in Feature 1. The analysis of the knapping debitage as well as of the discarded axe blanks has confirmed that a variety of working methods were carried out inside and outside Feature 1 by persons showing very different levels of technical competence. This pattern does not conform to a highly specialised workshop, nor to domestic production with a specialised working tradition passed from generation to generation.³ Rather, the combination of technically diverse, and at the same time more and more intense knapping during the last 250/150 years,

suggests collective production carried out by a team of part-time knappers and polishers, whose target was mass production rather than the development of a high degree of technical expertise. The lack of concern with raw material maximisation indicates that good dolerite stone was abundant and easily accessible.

Access to the dolerite stone was not exclusive to the inhabitants of Hiregudda. The lithic records of Choudammagudda and Sannarachammagudda show that these settlements obtained natural slabs or blocks as well as half finished blanks from the same dyke (Fig. 8). Percussion tools as well as dolerite debitage confirm that their populations were producing or finishing axe blanks. Differences in the organisation of axe production between communities emerge in the intensity of finds rather than in the organisation of activities. Thus, while discarded axe blanks represent around 30% of the macro-lithic tools recorded at Hiregudda Area A, their importance drops to around 10–15% at the other sites (Fig. 8).

The results obtained from the other settlements do not show a superior or inferior degree of technical competence among their knappers. Discarded blanks from Choudammagudda and Sannarachamma show the same type of working procedures and mistakes in comparison to the areas close to the quarry, although axe production was clearly a less important activity. Handstones, a clear indicator of the processing of cereal and other crops, represent more than 30% of the macrolithic tools recorded through systematic surface survey in these two settlements. In Hiregudda they only represent around 24% of the macrolithic assemblage. The frequency of surface grinding slabs and hollows is much larger at Choudammagudda and Sannarachamma than at Hiregudda, also suggesting differences in the activities conducted in the settlements (Fig. 8).

Fig. 8.
Relative proportion (100%=1) of the main stone artefact categories in the three settlements of the Sanganakallu-Kupgal archaeological complex (axe blanks, hammerstones, polishing hollows are mainly related to axe production; handstones and grinding hollows are the main food processing tools). These results are based on systematic surface recording of artefacts. Comparison with the material from test trenches shows a high correspondence between values.



The hill settlement of Choudammagudda, located 700 m southwest of the dolerite quarry, is characterised by a significantly high number of surface axe grinding hollows. Given its size, it may have been occupied by the largest community of the Sankanakallu area (although still limited excavations suggest that deposits may not be as deep as at the other sites) and it is possible that it could therefore have devoted more work force time to axe polishing. The large number of handstones, grinding slabs and grinding hollows recorded on the surface suggests the permanent character of this settlement and the importance of the processing and consumption of agricultural products within it.

The southernmost settlement of the Sanganakallu-Kupgal complex, at Sannarachammagudda, has a surprisingly high proportion of percussion stones, particularly of dolerite and gabbro, confirmed both through surface survey and excavation (trench 10). The presence of dolerite blocks, flakes and blanks on the site confirms that this community obtained useful raw materials from the Hiregudda quarry and participated in axe production. According to the length/weight index of axe blanks used to describe technical competence, the knapping skills at Sannarachamma were not lower than those displayed at Hiregudda (Fig. 9). Other aspects of the knapping process show that all three sites shared the same technology and expertise. However, the high proportion of hammerstones at the southern hill site can also be related to the knapping of other materials, including the production of small flake and bladelet tools on quartz and chert, as well as to the preparation and maintenance of cereal grinding tools, which have here a similar importance to that observed at Choudammagudda (Fig. 8). Finally, the low number of grinding hollows and grooves indicate that a limited work force was devoted to axe grinding at this site.

In general, it can be concluded that *the same set of stone tools and raw materials were produced, maintained and used on all three hills*. All settlements had direct access to the dolerite quarry or, at least, to the products produced there, as the presence of unworked blocks and blanks suggest. *Economic differences existed among the settlements as demonstrated by different work efforts and the different activities performed at the settlements*. While Hiregudda, and particularly Area A, centred on the quarrying and working of dolerite, the other settlements appear to have been more agriculturally-oriented. The transactions between the settlements seem to have been fluid given the exchange of materials and technologies between them. One might even

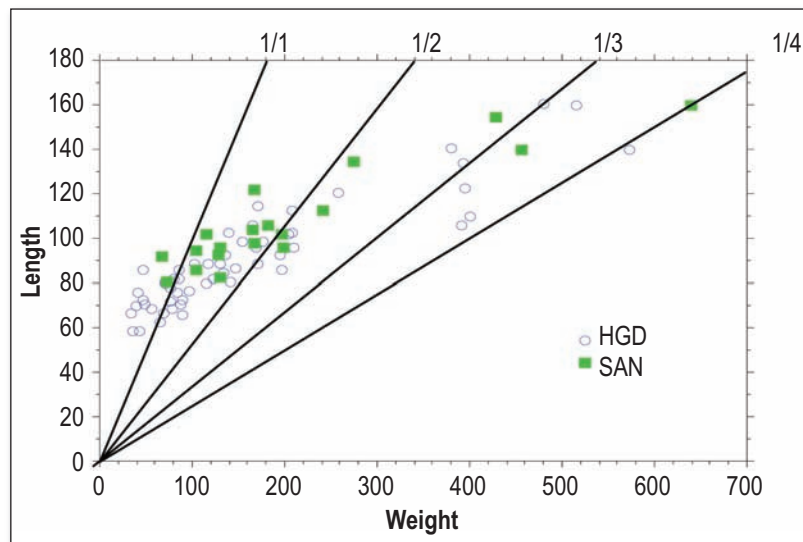


Fig. 9. Differences between Hiregudda (Area A) and Sannarachammagudda (Trench 10) in relation to the length and weight ratio of axe blanks. Lines mark the relation between length and weight and are therefore indicative of higher (left) or lower (right) technical competence.

ask if Area A, at least during the final occupation phase, was more of a working area used periodically by groups coming from the other settlements, rather than a settlement by itself. In any case, the presence of a considerable amount of crop grinding hollows as well as the evidence from Feature 1 itself, suggests that everyday subsistence activities were not unusual in the area.

The distribution and organisation of the means of production in the Sanganakallu area indicates a considerable circulation in terms of populations, raw materials, axe blanks, technological skills and, expectedly, subsistence goods between the three hill settlements. *The division of tasks within this society seems to have been limited*, and in general all communities living in this area were engaged to a certain extent in the flaking, pecking and grinding of dolerite axes. However, the production of chisels appears to have been restricted to one area close to the dolerite outcrop. So far, the study of the *lithic means of production does not suggest any marked division of labour between settlements nor in the excavated house units. Neither can signs of economic centralisation be identified in the area*. Yet, the scale of axe production leaves no doubt that we are not dealing in any of the three hill-settlements with a self-sufficient communal production. No approximate calculation of the total volume of axes produced in the Sanganakallu area has been carried out so far, but the figure definitely lies in the many thousands, rather than the hundreds. The manufacture of such quantities of utilitarian objects only makes sense if an extra-regional distribution system existed.

In this socio-economic context, it is of interest that *the most highly specialised activity area discovered so far lies separated from all settlement*



areas, c. 400 m southeast of Sannarachamma. On several more or less flat granite bedrock surfaces across an area of c. 30x25 m, we have recorded up to 138 grinding grooves.⁴ Probably their original number was much higher, given erosion processes and destruction caused due to their position next to the modern village of Sanganakallu. All grooves show the characteristic V section already observed around Feature 1 of Hiregudda, although many are much larger, reaching up to 100 cm in length (Fig. 10). In fact, they are the result of a successive juxtaposition of several shorter grooves. Such grooves do not seem appropriate for the grinding or polishing of the axes, nor their cutting edges, which require wider, flat or U shaped grooves, as know from African, Australian as well as European axe production areas (e.g. Shaw 1944; McCarthy 1976:54). Rather, these grinding surfaces seem to be the result of the polishing of the lateral margins and the butt of the axes and, in consequence, they must be related to the finishing of axes or chisels.

Although the labour force responsible for the development of such grooves is considerable, as became manifest in the experimental tests, no settlement traces can be identified in the neighbourhood. Even if the modern village may

have disturbed such deposits, surface finds should be expected. The clear spatial separation of this area must respond to an intentional social or political decision, as no significant geological differences exist between this bedrock and the granite forming the surfaces of all three inselbergs. In fact, similar lateral grinding was carried out at a much more limited scale on Hiregudda Area A and occasionally also on Sannarachamagudda. Consequently, these specific axe grinding activities and/or the persons carrying them out were maintained apart from the everyday habitation areas. Our impression is that other groups were present in this specialised area. Its position on the plain, south of the two largest habitation sites and away and out of sight from the dolerite quarry would be an appropriate location at which to engage with communities of a wider region and carry out the exchange of either axe blanks or more or less finished products. Perhaps the finishing of the axe margins in such a context of negotiation might have been considered a proof of the value of the offered products. Alternatively, axe finishing may have been carried out by the visiting groups themselves, or by diverse communities during the course of social and exchange activities.

Fig. 10.

Partial view of the area with polishing grooves located in the plain below Sanarachammagudda and next to the modern village of Sanganakallu (Photograph by J.A. Soldevilla).



Conclusions

The Sanganakallu-Kupgal area represents a unique archaeological complex in South Asia. Given that there has been a reprieve in the present-day quarrying of the granite inselbergs, the archaeological sites of the area will continue to offer exceptional opportunities to investigate the social and economic organisation of prehistoric axe production strategies. The research carried out so far shows that at least three hill settlements, probably with a few hundred inhabitants each, were engaged in the quarrying and working of a special type of dolerite. Its easy extraction, fine-grained texture and extreme hardness made it a highly suitable raw material for the manufacture of chisels, adzes and axes through flaking, pecking and intense polishing. The access of all three settlements to raw material, and the similarity across them of working techniques and artefact types, indicates that the communities shared basic economic resources and were closely related. Accordingly, a marked division of tasks between the hill settlements did not develop. Apart from axe manufacture, all communities were engaged to some extent in other tasks, such as food processing, pottery-making, bead production, etc.



The botanical evidence from Sannarachama and Hirregudda Areas A and D also points towards similar agricultural practices to each other and the broader regional culture, based primarily on the cultivation of two types of millets (*Setaria verticillata*, *Brachiaria ramosa*) and three pulses (*Macrotyloma uniflorum*, *Vigna radiata*, *Lablab purpureus*). The increase of wheat and barley in the final stages of occupation is detected in both settlements where carpological studies have been undertaken (Fuller *et al.* 2001; Fuller *et al.* 2004; Fuller 2006:48–53). Evidence of associated weed seeds and limited chaff (and hulled millet grains) suggests that archaeobotanical data derives from routine dehusking and final winnowing activities, and that initial threshing and winnowing after harvest was carried out elsewhere and not on occupation sites (Fuller *et al.* 2004:117). The presence of quernstones and some grinding hollows on the hills suggests the context for final processing on these hill sites (Fuller *et al.* 2001), although it is now clear that large, round and shallow food-processing features must be distinguished from the more narrow and deep features involved in axe production (a distinction not recognized in the earlier paper of Fuller *et al.* 2001). Faunal evidence indicates the predominance of domesticated cattle, sheep and goat meat in the diet, with a small proportion of hunted game, mainly of antelopes and deer (Korisetar *et al.* 2001b). Evidence from recent context based analysis, including evidence for burying and cutmarks, suggests that caprines may have been the mainstay of the diet, with cattle restricted to larger consumption events (feasts) (Boivin *et al.* 2005:74–5; S. Meece, personal communication). These subsistence data suggest household or kin-group-based production strategies rather than specialization between households, while the cattle evidence suggests some inter-household communal consumption events, which might have coincided with periodic communal axe mass-production episodes on the one hand and ash-mound conflagration events on the other (though these events need not have been contemporary).

A further outcome of the limited division of tasks is the importance of unskilled flaking procedures apparent on axe blanks. Even the prismatically shaped dolerite blocks could be worked by knappers with insufficient experience. Such an economic pattern implies that the intensification of production taking place between c. 1750–1250/1200 cal BCE was not achieved through an increase in productivity, but rather through the larger number of per-

sons participating in the manufacturing process. Under such circumstances, raw material scarcity cannot have been a relevant economic consideration at that time.

One exception in this general tendency seems to have been the preparation of long cylindrical chisel blanks. Survey and excavation data suggest that these tools were flaked and probably polished by highly skilled knappers working (and living?) in Area A of Hiregudda, more precisely in the area dominated by Feature 1. Otherwise, economic differences between the settlements were restricted to the relative importance of the different activities in the communities. Occupation areas close to the dolerite dyke devoted more work force to the preparation of axe blanks, while at a further distance, subsistence production and possibly the production of other types of objects was more relevant.

The final polishing of the axe edges was carried out in a special area located on the plain and separated from the hill settlements and the dolerite dyke. Covered with over 100 narrow grooves, this area must have represented a particular place of production, but possibly also of communication and exchange with other communities. However, a large proportion of the axes must have left Sanganakallu in an unfinished state. Axe blanks of similar shape, rock texture and colour have been found in other prehistoric sites of the Deccan, where evidence of flaking is absent or marginal. One example is Piklihal, located c. 100 km northwest of the Hiregudda outcrop, where 14 axe and chisel blanks and 29 dolerite flakes were found (Allchin 1960). The flakes seem to have originated from broken axes or the reworking of axes. Similar evidence is reported from Budihal (Paddayya 2001:198).

The existence of a large-scale distribution network for blanks and finished tools (the existence and precise organisation of which still needs to be investigated) also agrees with the scale of the quarrying and knapping activities identified in the Sanganakallu-Kupgal complex. Moreover, the absolute chronology has confirmed that the phase of massive production only lasted a few centuries, between c. 1500–1250/1200 cal BCE, i.e. the time which corresponds to the transition between the local Neolithic and the Iron Age. The expected wider economic implications of such a marked intensification in the production of wood-cutting and wood-working instruments are increased land clearance, expansion of agricultural land, and demographic growth in the Deccan. The appearance of copper ornaments and weapons,



and textile manufacture, all starting before ca. 1500 BC, with the addition of tree crops, wheel-finished pottery and iron by 1200 BC, also hints at a time of economic change (Fuller *et al.* 2007). So far the distribution of working instruments, as well as of highly valuable objects, such as stone, shell and metal beads, in the Sanganakallu-Kupgal area does not allow us to relate this production increase with a clear social differentiation between as well as inside the studied settlements. As can also be observed in other geographical and historical contexts, a qualitative change in the social relations and the appearance of a dominant class frequently takes place only after society has gone through a phase of economic intensification. In this sense, the appearance of Megalithic burials by 1300–1200 BC probably testifies that the emergence of social and political elites coincided with the conclusion of large-scale axe production activities at Hiregudda.

Notes

- 1 Foote (1916:82), a geologist who travelled widely through southern India, mentions that the occurrence of such weathering dolerite outcrops was a very unusual phenomenon for the trap-dykes which occur in such great numbers on the Deccan plateau.
- 2 This agrees with observations made by Stout (2002) among the Langda adze makers of Irian Jaya. The more skilled knappers produce longer but not wider or thicker blanks. Consequently, high technical competence results in proportionally lighter artefacts.
- 3 While a typical example of the first is the modern production of beads in Khambat, Western India (Kenoyer, Vidale & Bhan 1991), the domestic type of specialisation would include the blade production proposed for the Magdalenian of the Paris basin (Pigeot 1987). For a general discussion on the meaning of technical specialisation, see Risch (2008).
- 4 For previous discussion of these grinding grooves, see Subbarao 1948; Brumm *et al.* 2007:73.

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The ritual use of axes

Abstract

In southern Scandinavia, the recovery of tens of thousands of flint axes makes them one of the most common tool types from the Neolithic (4000–2000 BC). Some complete examples are often found in association with graves, especially outside the passages of megalithic tombs from the late part of the early Middle Neolithic (3000–2800 BC). However, the majority are found in former wetlands. A detailed study of a small area in southernmost Sweden has revealed that flint or stone axes were deposited in almost every single bog. Judging by the finds of knapping debris, flint axes were manufactured close to places of special importance such as enclosures. The transformation of axes by fire is also a common habit in southern Scandinavia. Fragments of burnt axes are found outside megalithic tombs, in enclosures and within special deposits. A site with intensive manufacture of stone axes, deliberate destruction of stone axes and fragments of burnt flint axes at Stensborg, central Sweden, will be used as a focal point in the discussion.

Introduction

Flint axes are one of the commonest Neolithic (4000–2000 BC) artefacts found in southern Scandinavia. The vast majority of the tens of thousands that we know of have been recovered from former wetlands. In fact, detailed work in southern Sweden suggests that flint or stone axes were deposited in almost every single bog. Judging by finds of knapping debris, flint axes were often manufactured close to places of special importance such as enclosures. Examples also appear in graves, especially outside the passages of megalithic tombs from the late part of the early Middle Neolithic (3000–2800 BC). There is also evidence that many axe blades saw forms of treatment that involved transformation by fire, deliberate destruction and purposive deposition. These details of context, form and treatment suggest that axe blades were often of great symbolic significance to Neolithic communities, implicated in the reproduction the social world. This paper uses ideas derived from practice theory to explore the nature of that significance.

Theories of practice

Practice theory is a shorthand for approaches which have as their goal the understanding of social reproduction. Concerned with the relationship between agency, structure and history, they acknowledge that this process unfolds within specific material and historical conditions. They also hold as central that the structures of any society are woven into different aspects of life, from the most mundane of routine practices to the more formal and prescribed moments of ritual (Bell 1997; Ortner 1989; Sahlin 2000). It is in the playing out of these varied practices, as people pursue particular interests or respond to those of others, that structures are renewed and redefined.

Significant across the social sciences, practice theory has proved influential in exploring the kinds of conditions that anthropologists or sociologists trace in the field. At first glance, therefore, it might seem of only limited value to archaeologists. However, most social practices are inherently *material* in character. They *involve* people with things; in the context of carrying out daily tasks and in the conduct of important ceremonies. From this it follows that the patterning of material culture is both medium and outcome of the processes we wish to understand. Not only that, it is material that we study diachronically, a characteristic that allows us to

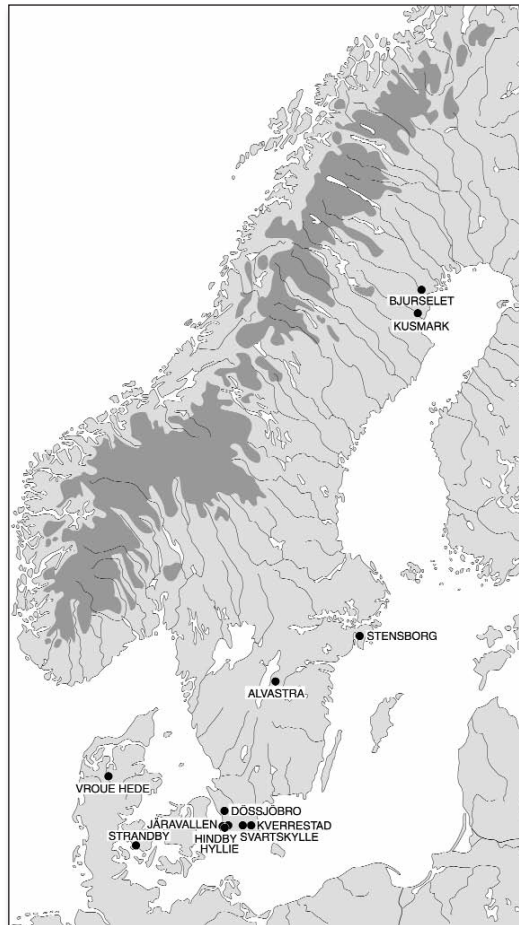


Fig. 1.

Scandinavia with sites mentioned in the text.

explore the persistence of tradition and of social memory, particularly in settings we might recognise as ritual (De Boeck 1995; Nilsson Stutz 2003).

These arguments find a clear expression in a recent study of the Neolithic of Southern Sweden, which concludes with the statement that “...culture is ideology...” (Malmer 2003: 184). The question that remains, of course, is how we might recognise particular world views, ideas and values archaeologically. In the case of flint axes, we can certainly identify evidence for structured forms of treatment; from the conditions in which certain blades were made to the manner in which many were deposited. But we can only begin to make sense of that evidence once we recognise the close categoric and biographical links that often join people and things. For example, tools have a birth, an active life and a death. How the process of birth and death is dealt with depends, as for people, on how particular tools and materials are evaluated, a process that can vary from one example to another. In other words, the ‘life’ of a tool might take different paths depending on decisions taken by individuals or by collectives. The duration of that ‘life’ might also vary; in some cases no more than days, in others, as with heir-

Fig. 2.

Stone axes from the settlement site Stensborg, middle Sweden.

1:

fragments of stone axe with hollowed edges;

2–3:

fragments of thin-butted stone axes; and

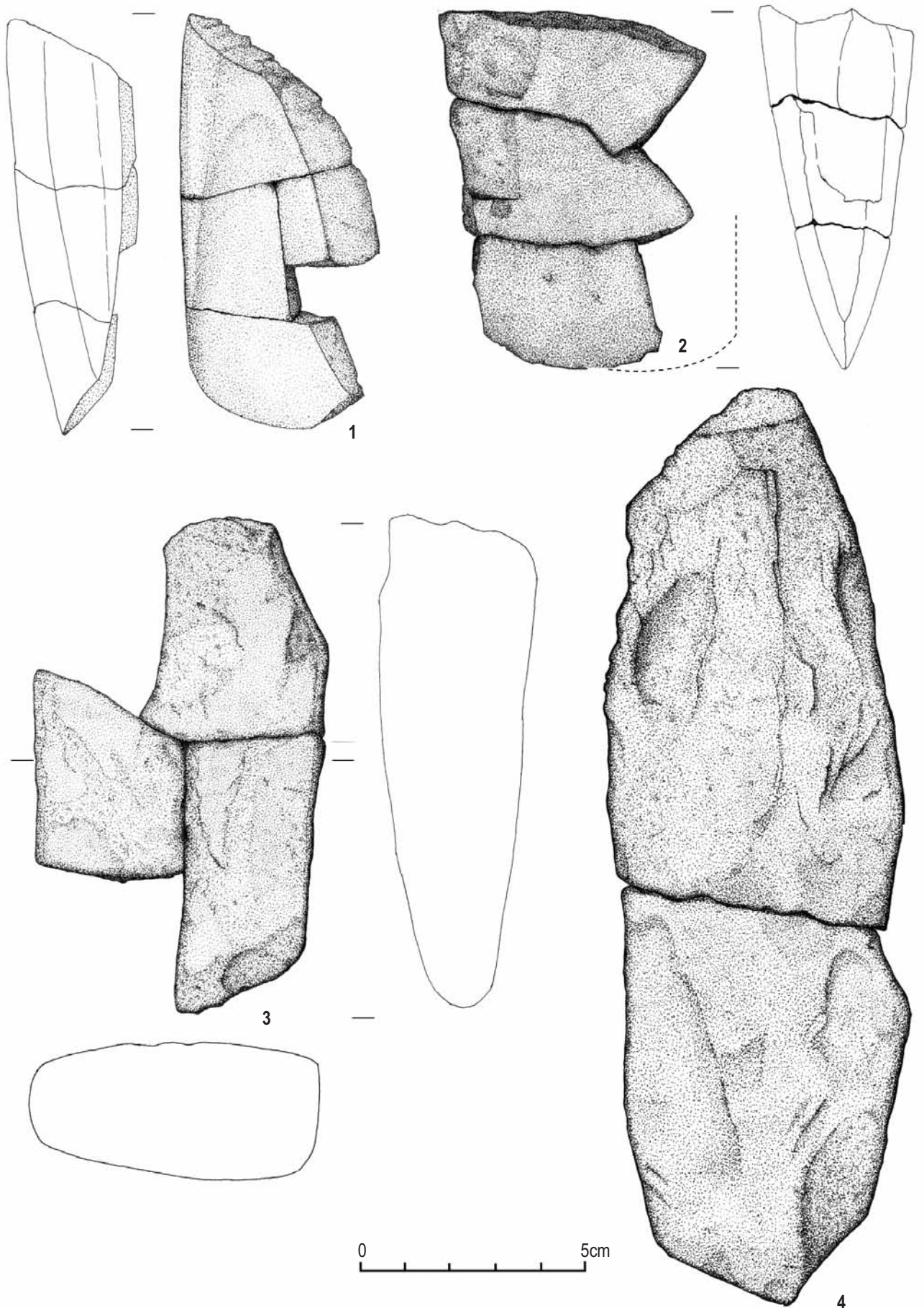
4:

preform of a stone axe.

All stone axes are intentionally damaged and the edge of no. 3 is blunt.

Drawing by Krister Kam Tayanen.





looms, a span that exceeds several human generations (Hakiwai & Smith 2008). In some instances, special artefacts can even be regarded as more valuable than people, possessing names and biographies that are well-known to the community.

One site in particular provides a lens through which to study the ritual significance of Neolithic axes. Stensborg, on the northern border of the Funnel Beaker culture in the Mälardalen region, lies c.30 km south of Stockholm and has been the focus for field collection over the past twenty years (Broström 1996) (Fig. 1). During the early part of the fourth millennium BC, the site was situated on an island in a large archipelago. At 35m above the

present sea level, the settlement was located close to a deep and narrow inlet. On a field sloping towards the present valley, a large number of tools were found. As many as c.500 pre-forms of stone axes in different stages of manufacture, about 100 finished axes, c.100 chisels and a considerable number of fragments of flint axes damaged by fire are included in the collection, the largest found in central Sweden (Broström 1996:69) (Figs. 2–3). Several hundred hammerstones and polishing stones show that axe manufacturing occurred within the settlement. The range of raw materials, manufacturing stages and forms of treatment present on the site are unparalleled elsewhere.

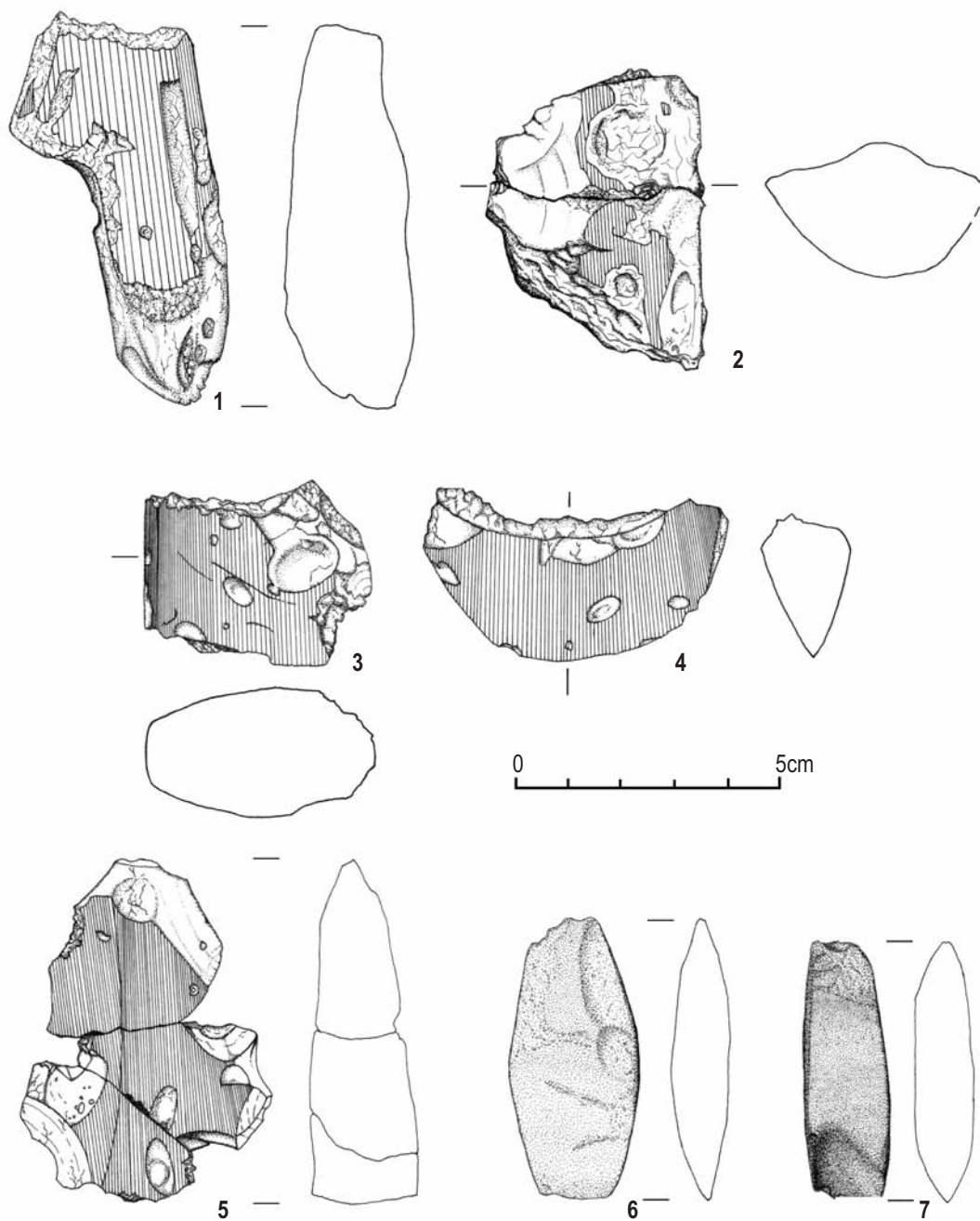


Fig. 3.
Axes and chisels from the
settlement site Stensborg,
middle Sweden.

1 and 5:
fragments of burnt
point-butted flint axes;
3–4:
fragments of burnt
thin-butted flint axes; and
6–7:
stone chisels.

The flint axes are
all damaged by fire.

Drawing by
Krister Kam Tayanen.



Handling axes

Survey and excavation at Stensborg have revealed a marked spatial division across the site. The vast majority of stone axes and pre-forms were found on the 50m wide slope close to the sea shore. A small excavation in 2008 recovered a small amount of axe-manufacturing debris. However, further work demonstrated much greater volumes of debris on a ridge above the wide slope, suggesting that this latter area was the main focus for occupation and blade production.

The slope might have functioned as an assembly area where certain rituals were performed. It had a specific setting with a remarkable depth just behind the shore line easy for vessels to approach. The site is also defined and to some extent surrounded by natural 'obstacles'. On the opposite side of the slope a ridge marked the limit. To the south and north the site was delimited by rifts with steep sides, eroded by small brooks (Fig. 4). The details of this setting parallel those seen on Causewayed Enclosures in Southern Scandinavia, which often recruited natural features to define or reiterate their boundaries, adding to the lines drawn by palisades and pit systems. One can envisage other kinds of enclosures within smaller social systems that might just be surrounded by natural obstacles, and Stensborg might be one such example.

The finds from this site show a marked difference from those at most settlement sites. The large number of axes might instead be related to other kinds of site where the axes play an important role in activities that have for a long time been regarded as ritual depositions in Southern Scandinavia.

The Stensborg assemblage highlights several factors that shaped the significance of axes. To

begin with, the symbolic or social significance of a tool was in some instances related to the availability of raw material. The majority of the axe blades produced at Stensborg were made of greenstone, diabase or basalt, pebbles of which can be found in the eroding banks of a small brook to the immediate northeast of the site. Most of these blades show irregularities which indicate that little effort was devoted to maintaining any kind of formality in their manufacture. In their variety, they resemble the stone axes that appear during the Late Mesolithic (Lindgren 2004). They were certainly functional tools. But like their Mesolithic counterparts, they may have also held additional significance, a possibility suggested at the Late Mesolithic site of Sjövreten, not far from Stensborg, where two axes were found placed close to each other (Welinder 1977:53). Another category of working tool at Stensborg is the chisel formed out of a stone flake with a ground and/or polished cutting edge. There are also c. 50 stone axes with a more regular shape, with a rectangular cross-section copying the most common flint axe, the thin-butted type. For these, much more care was invested in manufacturing, knapping at right angles and with a careful grinding/polish over the entire body. The same is true of axes with hollowed edges, a special type known only in this northern part of the Funnel Beaker culture area.

Other raw materials are also represented, some of them from more distant sources, a quality that seems to have influenced the manner of their working. For example, most of the distinctive thin-butted stone axes and those with a hollowed edge are made of porphyritic rock that is not available nearby. Moreover, Stensborg is located at least 600 km north of the southernmost part of Sweden or eastern Denmark, where flint of a size and quality for making thin-butted axes was available. Here at least, the distances involved may have conferred a particular importance on the thin-butted flint axes recovered on site, an importance reflected in their subsequent treatment. The majority of the thin-butted axes are found in fragments, a few also showing marks of exposure to intense fire. They are intentionally cracked in pieces and the edges of some are heavily damaged as if they have repeatedly been hit against a rock. This is particularly the case with the flint axes from the site, none of which have been recovered intact. Wear and repair traces on a number of these suggests that whatever else they may have meant, they nonetheless saw practical use. What matters here is that all were damaged by intense heat, at least one example burnt whilst

Fig. 4.

Aerial photograph of the Stensborg site. In the centre the field with the large number of surface finds.

The trees just above the field mark a ridge. The dashed line marks the sea level at the time of the late Early Neolithic (at 35 m above sea level). To the left and right the outlets of two small brooks forming deep ravines below the trees are visible.

The landscape was radically changed when a golf course was established.



still in an unfinished, unpolished, state. It is difficult to arrive at an estimate of the size of axes based on more than five hundred fragments, though at least some were of a size comparable to the larger examples in southern Scandinavia. Numbers are also difficult to calculate, though there might have been as many as twenty. From the shape of the fragments, about 70% had a thin-butted shape while the remainder were point-butted type. In southern Sweden, the point-butted axe is rarely found damaged by fire.

Depositing axes

More broadly, the hoarding of flint axes, particularly thin-butted forms, provides further hints as to their significance. Hoarding was a common phenomenon in southern Scandinavia. In Denmark, 171 hoards with a total of about 500 axes are known (Nielsen 1977: Fundliste I). By contrast, 122 hoards, containing a total of 316 axes, are known from the much smaller Scania (Karsten 1994:55). Whilst differences in recovery opportunities and procedures may have influenced the pattern, these numbers do at least suggest that Neolithic interest in depositing axes was greater in southernmost Sweden than it was in Denmark. Across this area, the character and content of hoards suggest the recognition of principles of classification and of conventions surrounding what, where and how axes of different materials could be deposited.

Some of these conventions were persistent. During an early part of the Mesolithic there seems to have been a division between the unpolished flint axe and the polished stone axe, a demarcation that is not broken until the beginning of the Neolithic. From then on, the polished flint axe becomes the standard for shapes that are accepted for axes in all other types of stone as well as the changes that take place through time. One of the most common elements in grave assemblages, flint axes were not simply tools, they also carried other values, associated with men and perhaps with the standing of individuals within the community. Flint axes and people thus became interacting entities. The way in which they were handled may reflect events that were important both for individuals and for a wider community.

When looking at the axe blades themselves, a number of patterns can be identified. Technically at least, the biography of a blade can be said to have several stages, from rough knapping to fine flaking, through grinding and

polishing to various kinds and degrees of use (Olausson 1983:28; Strassburg 1998, 2000). By establishing how blades were treated at various points along this line, it becomes possible to speculate on the kinds of protocols that guided both how and where a blade could be deposited, depending on the point that it had reached in its 'life'.

The most basic of these protocols concerned the differentiation of polished and unpolished blades. Out of a total of 63 thin-butted flint axes found in graves from Denmark all are polished (Nielsen 1977: Fundliste II). Unpolished axes have been found at tombs, but in these cases in association with the frame of stones *outside* the chamber (Nielsen 1977: Figs. 45–46). In hoards from Denmark with thin-butted axes, 54% are unpolished (Nielsen 1977: Fundliste I). One can also identify an interesting change, with the lowest percentage of unpolished axes in hoards with the earliest types (24%) and the highest percentage for the most recent axe forms (87%). The hoards of thin-butted axes from Scania show the same percentages of unpolished axes as found in Denmark (Karsten 1994:56).

The norm for selecting polished axes as grave gifts can also be identified in the later Single Grave culture of Jutland and northernmost Germany during the Middle Neolithic, almost a millennium later. Out of 174 axes from 161 graves, just one is unpolished and is, in fact, little more than a preform (Ebbesen 1983:123–127). However, in hoards the unpolished thick-butted axes make up 47% and among the thick-butted gouges, the figure is as high as 76% (Ebbesen 1983:148–149). In Sweden also, all grave gifts of thick-bladed flint axes, a total of 142, are polished (Malmer 1962:390). Most of these are concave-edged. In hoards 65% are unpolished (Karsten 1994:69).

These comparisons demonstrate a major difference in how polished and unpolished axes were handled. Never or very rarely was an unpolished axe deposited in a grave, while it was fully acceptable as part of a hoard. The relationship of polished and unpolished axes in one and the same hoard probably conveyed a subtle meaning as individual blades would have had very different histories/biographies. The number of polished axes in hoards from firm ground is much higher than those in wetlands (Karsten 1994:69). This hints at similarities to the practice for depositing axes in graves where polished axes are the norm. However, the most important point is that the main norms for the deposition of axes appear to have been much the same in 3500 BC as they were in 2500 BC.



The birth of axes

The ritual importance of axes seems to have been caught up in wider social and cosmological spheres, so much so that even their manufacture could involve a certain contextual formality. During rescue excavations in a valley at Dösjebro in western Scania (*Fig. 5*) a Neolithic ritual complex was revealed on both sides of a small river. It included a palisade structure, graves from the Battle Axe culture and an area with intensive flint axe production (Andersson 2003; Runcis 2008). Debris from axe production was also found in some of the post-holes of the palisade structure. The area does not have flint nodules useful for axe manufacture, so the raw material had to be brought from the south-west, at least 20 km away. The palisade structure is dated to the late Funnel Beaker culture or early Battle Axe culture and the axes produced seem to be of the same age (Svensson 2002).

A similar connection is also evident at another palisade site at Järavallen in south-westernmost Scania (Svensson 2002:38). The palisade is located just a few hundred metres from the beach on which flint nodules are numerous. A large number of axe preforms have been found along the beach (Salomonsson 1971:80). At Hyllie, less than 3 km from Järavallen, yet another palisade was identified and partly excavated (Svensson 2003). Later, almost all the remaining parts were excavated (Brink 2004). In some of the post-holes copious debris from axe fabrication was found.

In both these settings, the close chorological and chronological connection of a ritual structure and axe production indicates that manufacture, or part of the manufacturing process,

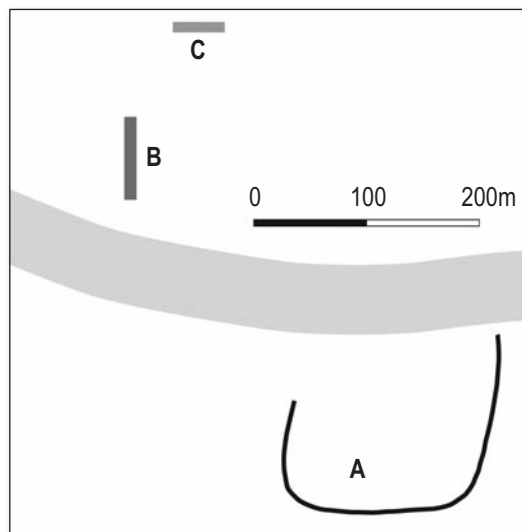
was included in communal ceremonies related to a sacred area. In this case the fabrication or birth of axes was connected to wooden structures. This might give a special perspective on the biography of axes. The relationship between the softer wood and the harder stone has been presumed to encapsulate an important dualism between birth and death, when the human body grows harder with time and is transformed into stone after death (Parker Pearson & Ramilisonina 1998a:313, 1998b).

Fragmented axes

The fragmentation of an axe was sometimes deliberate, and concerned with marking the death or passage of the blade itself (Bradley 1990). Because of their categoric and biographical associations, axes were integrated in that part of the conceptual world that concerned those who had physically left the community, although they were still active as agents between worlds. Most axes, like people, ended up in anonymity, the former as raw material for other tools some of the latter at best as fragments within megalithic tombs, causewayed enclosures (Andersen 1997) or at other sites of ritual importance (Malmer 2003:103). People as well as axes were also deposited in their entirety or as fragments in wetlands (Koch 1998:155). There are even bog finds with hoards of axes as well as human remains (Bennike & Ebbesen 1987:96). Our knowledge of fragmented finds of humans and axes in wetlands is somewhat scanty, but one example suggests that they were more common than previously considered. The excavation of a small bog, Hindby in south-western Scania, revealed the remains of votive practice running through the Late Mesolithic, most of the Neolithic and into the Bronze Age (Berggren 2007). Along with a paired deposit of axe blades, there are more frequent combinations of tools, sometimes broken up before deposition, as well as bones of animals and humans. One deposit contained a burnt fragment of an axe, two human bones and three pig eye-teeth. These show that fragmentation by cracking and burning followed by sorting was carried out before deposition.

Outside of controlled excavations, these deposits with significant degrees of prior fragmentation are very difficult to recognise. The simplicity and diminutive appearance of individual elements make it likely that they would be missed in passing far more frequently than intentional votive deposits containing complete artefacts. At least then, it is likely that such frag-

Fig.5.
The relations of the
henge structure (A),
dated to the late
Funnel Beaker culture/
Battle Axe culture,
the cemetery from the
Battle Axe culture (B)
and the axe
manufacturing site (C),
on both sides of a
small river at Dösjebro,
western Scania.



mented deposits were rather more common than we have so far acknowledged. This can be supported by the results gained from surveys of an area of about 20 sq. km. in the southern-most part of Sweden where about 80 hoards and single finds most made up of flint axes were recognised (Larsson 2001, 2007). Most of the hoards were found in farm collections but some included fractured tools, and objects of indeterminate type were identified during surveys.

Transformation by fire

A special form of fragmentation is the effect of fire. Finds from settlement sites indicate that the ritual burning of flint artefacts was well known throughout the Neolithic. Fire alteration of tools is relatively frequent at sites throughout the Neolithic (Karsten 1994; Malmer 2003:41, 74). The burning of flint axes could be accidental, but at several sites the percentage is too high, often higher than 20%, to be viewed in such mundane terms (Karsten 1994:159). Most sites show marked differences according to the tool types affected by fire. There is also evidence that the firing of axe blades was itself highly structured. The alteration of flint by direct fire provides different products of fragmentation than those seen on many sites. Simple exposure to high temperatures usually results in the fragmentation of flint artefacts into very small pieces. This is not what we find with many burnt axes, which are often recovered as larger than expected fragments. This suggests that axes were often heat-treated before they were placed on the fire (Larsson 2000). The intention was not to destroy the axes entirely, but keep them in as large parts as possible even after their transformation by fire. At almost every site, axes are more affected than any other type. This phenomenon is chronologically independent – from the earliest Early Neolithic to the latest Late Neolithic. Alteration by fire, however, seems to be most common during the Middle Neolithic, including the late Funnel Beaker culture and the Single Grave culture.

A special and so far rare type of sites with examples of fire-altered flints may be found on a plateau within an area of approximately 70 x 70 m at Kverrestad, south-eastern Scania (Larsson 2000, 2002). Excavations revealed a number of pits of varying size and depth in which flint and stone artefacts affected by fire had been deposited together with a considerable amount of fragmentary pottery (*Fig. 6*). The largest pit was about 4 m long, the shortest less

than 0.5 m. Finds were made throughout the filling, which shows that the artefacts were deposited during the entire process of filling in the pits. Fragments from about a hundred thick-butted concave-edged axes and chisels have been found, as well as arrowheads and other flint and stone tools (Larsson 2000). A small number of burnt human bones, intentionally cracked into small pieces, were also found, providing another example of the combination of humans and axes. The finds are dated to the late part of the Battle Axe culture. As an interesting aspect of the 'life cycle' of axes, the axes at Kverrestad included rough, unpolished examples where the form was just shaped as well as examples with a very well executed polish of the entire body.

The choice of axes for burning, as recorded at settlement sites, is also obvious among the finds at Kverrestad. While more than 90% of the axe finds display changes by fire, c.65% of the scrapers, c.50% of the tanged arrowheads and c.30% of the arrowheads made by pressure-flaking have the same alteration by fire. These marked differences indicate intentional selection – some tools required treatment by firing more than others. Similar evidence has also been found at Svartsykke, some 17 km west of Kverrestad (Larsson 1989) and at Strandby, southern Funen (Andersen 2000:34). These two sites are dated to the transition Early Neolithic/Middle Neolithic and earliest Middle Neolithic. On both, preforms as well as polished flint axes were found.

Flint tools affected by fire appear in many instances in relation to megalithic tombs. Burnt tools seem to be less common in burial contexts dated to the Early Middle Neolithic. However, during a late part of the Funnel Beaker culture axes destroyed by fire are frequently found outside the entrances of tombs (Tilley 1996). Research on the late Funnel Beaker culture provides much more detailed knowledge about the deposition of material culture than about the deposition of humans. We actually know more about how axes were treated and placed in megalithic tombs than about the mortuary practice of humans in the same type of tombs. Human remains in megalithic tombs have been dated to an early use of the tomb or a much later use during the Late Neolithic (Persson & Sjögren 1995), less is known about how human remains were treated during the middle part of the Neolithic.

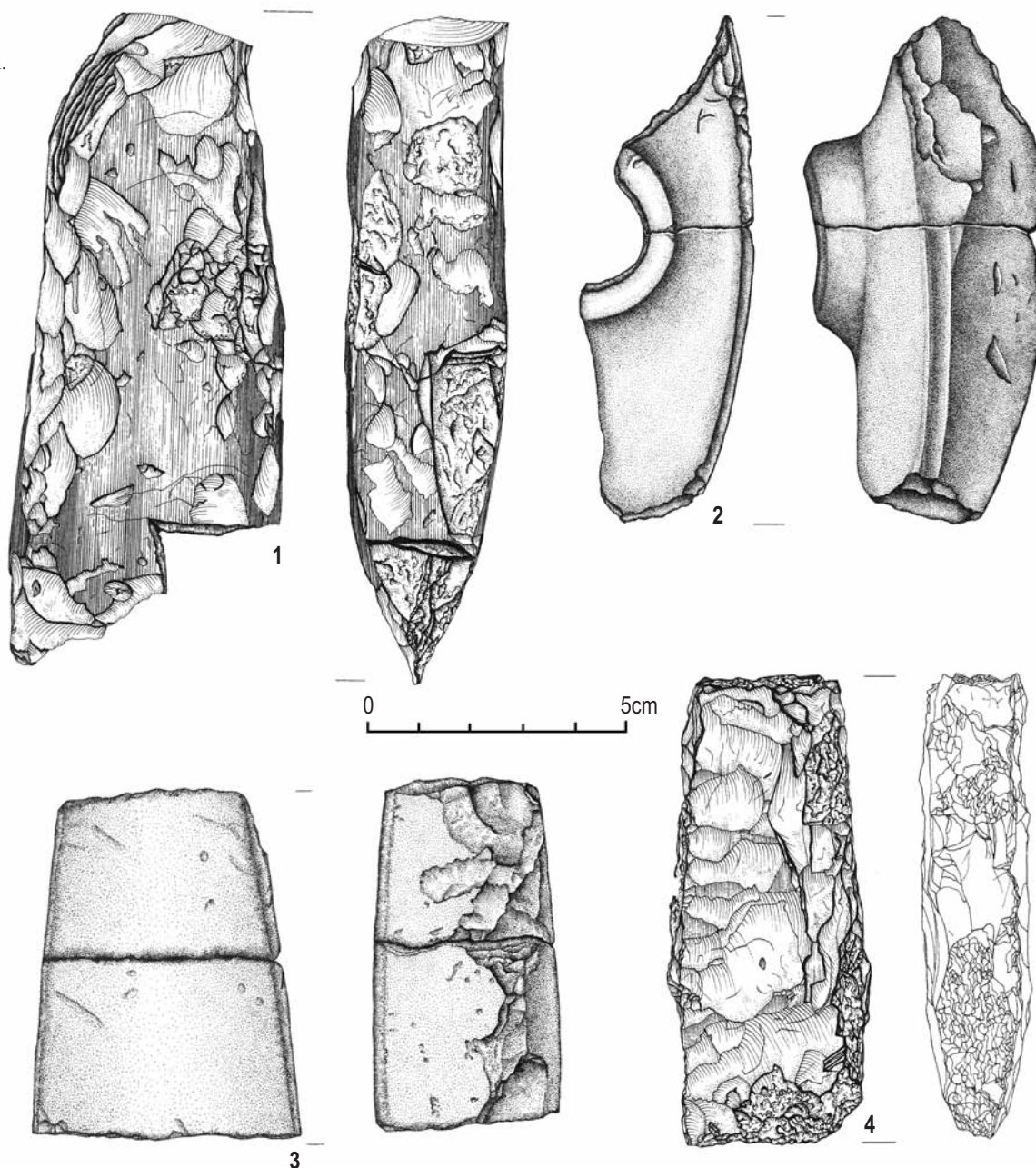
The involvement of axes and fire in complex mortuary practices is exemplified in Stone Setting Graves in northern Jutland, the majority dating to a late part of the Funnel Beaker cul-



Fig. 6.
Artefacts from Kverrestad.

1–2:
fragments of
thick-butted flint axes;
2:
fragment of a
battle axe; and
3:
fragments of
a stone axe.

Drawing by
Björn Nilsson.



ture (Jørgensen 1977; Fabricius & Becker 1996). Despite a predominance of flint axes in the graves, none is affected by fire. In megalithic tombs in connection with stone setting graves at Vroue Hede, however, burnt axes of the same period as those in graves were found outside the entrances (Jørgensen 1977:55, 123). This indicates that axes were burned in ceremonies related to collective manifestations while axes connected to individual interments were buried unaffected.

The phenomenon of burning is also evident in other parts of Sweden. For example, the pile dwelling from the Middle Neolithic at Alvastra, western Östergötland, includes remains of ritual activities. The site is dated to about 3100 BC and includes artefacts characteristic of the

Pitted Ware culture as well as the Funnel Beaker culture (Malmer 2003:103). Of the entire flint axes or large pieces of axes, several examples show effects of fire alteration (Browall 1991). A large number of fireplaces as well as strike-a-lights have also been found (Browall 1986). In the dwelling, carbonised grains as well as apples and hazelnut shells are frequent. Firing was of special significance at the site. At sites in northern Sweden such as Kusmark, evidence of flint alteration by fire has also been found. In this area, flint was a very exotic raw material because it had to be transported more than 1,000 km from the south. The fragments from Kusmark are remains of axes or chisels affected by fire (Knutsson 1988:86). The largest find of axes, at Bjurselet, contains about two hundred



blades of the same type as at Kverrestad. The finds have been identified as ritual deposits as the axes were placed in special arrangements (Knutsson 1988, Fig. 40). Some of the Bjurselet axes were deliberately affected by fire (Christiansson 1989:21).

Axes as people – people as axes

It is reasonable to assume that Neolithic societies gave at least some elements of their material culture characteristics similar or corresponding to people. Axes were integrated in everyday life, involved in various tasks and with particular people, they also featured in important ceremonial cycles. These practical, categoric and biographical associations could be implicated in the treatment accorded to blades at all stages in their life cycles.

Based on museum as well as farm collections, the number of flint axes, thin-butted as well as the later thick-butted ones, has to be counted in tens of thousands, yet one rarely sees thin-butted axes made by an unskilled flint knapper. The only locations where preforms appear showing low flint-knapping technology are the refuse dumps of axe manufacturing or a few hoards with axe-like flint pieces. These might be explained as being the products of an inexperienced knapper. High quality and a large number of axes require knappers that spend considerable time producing axes, true flint-knapping experts. Blacksmiths were known in late prehistory to possess the knowledge not only to master iron but also to master forces of the immaterial world (Østigård 2007). A similar status has been related to the knowledge and action of the bronze smelter (Goldhahn 2007). The flint-knapping specialist who made the axes might have acquired the same position. The knapper, like the axes, became positioned in a zone in between the living society and another world belonging to spirits and deities. Those involved in the birth of particular axes may have also been implicated in their death, transforming blades as part of the transformation of the deceased and effecting their transfer to the world of the forefathers.

These arguments bring us back to Stensborg. The stone knapper(s) at the site might have taken the lead when certain axes were going to be transformed, most probably during assemblies of people from farms across the island of Södertörn. Those assemblies may have been for many reasons, but they most likely included mortuary rituals that involved the cremation of

bodies, this being the common rite across Mälardalen at the time (Hallgren 2008). The evidence from the site suggests that amongst other things, the process of transforming the body also involved transforming key items of material culture and in the case of flint axe blades, this also involved prior heat treatment. This prior treatment was not, in most cases, a public, pyrotechnical, event with a huge fire, the cracking of heated flints and splinters flying out of the fire. Rather, it was a slow and largely silent process. It might even have been conducted away from the public gaze. The subsequent result; a slow colour change without intense cracking may thus have been all the more remarkable for those attending the more open and public moments of particular cremation ceremonies. The distribution of axe fragments over most of the slope at Stensborg indicates after their transformation by fire, a number were deposited in shallow pits, as has been recorded at other sites, or even directly on the surface.

The patterning at Stensborg reflects the operation of cultural choice according to a very particular logic. The process of heat treatment does not seem to have been applied to other materials on the site or earlier sites in the region. The large number of simple chisels found on site were not fragmented or heated, nor were simple stone axes. These could have been used in the building and decorating of wooden structures that were added for the public events. They were easy to make and were probably deposited after use without the kinds of treatment accorded to many of the flint axes. Because of their associations, the flint axe blades required a different kind of treatment, one that involved a very specific technique. This knowledge of what heat treatment involved was one element in a body of ideas that was brought to the north as part of the know-how involved in manufacturing thin-butted axes. The specialist flint knapper was the possessor of that information, transmitted from generation to generation, providing him or her with a special status.

Many more examples could be presented to confirm that the ritual use of flint axes in Scandinavia was structured by norms and conventions. What is interesting here is that these conventions cut across other boundaries of cultural diversity and are sustained despite changes in the form of axe blades themselves. How much the changed shape of axes had to do with function or aesthetics is difficult to say. The most important shifts seem to be linked with new ways of hafting the axe, with the shift



from thin-butted to thick-butted forms. But whatever the case, what mattered was the adherence to established principles regarding how, when and where axes were handled in ritual practices. Stability seems to have been more important than innovation. The meaning of ceremonies, or at least the knowledge of how ceremonies involving axes should be performed, was transferred from generation to generation without much change.

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■ ■ ■ Stone celts are held to preserve from lightning the house in which they are kept. They perspire when a storm is approaching; they are good for diseases of man and beast; they increase the milk of cows; they assist the birth of children; and powder scraped from them may be taken with some advantage for various childish disorders. It is usually nine days after their fall before they are found on the surface. ■

Sir John Evans
Ancient Stone Implements 1872

●●● So there I was, trying to measure all the axes in the collection, and the finest examples were on display. They let me into the cabinets, but each axe was glued to the hessian that lined the case. Trying to get the callipers in position, I accidentally pulled one of them off the backing, tearing the hessian in the process. Not a good start. ●



Primary and secondary raw material preferences in the production of Neolithic polished stone tools in north-west Turkey

Abstract

The paper presents the results of new research on the sourcing and petrology of prehistoric stone tools from north-western Turkey, using evidence from excavations and field surveys conducted during the last decade, which has added significantly to our knowledge and understanding of Neolithic stone tools, technology and society of the area.

Particular attention is focused on the Neolithic sites at Hoca Çeşme, Aşağı Pınar, Ilıpınar, Aktopraklık, Kaynarca, and Hamaylıtarla, where a broader range of rock types than previously thought appear to have been used for polished stone tool manufacture.

By differentiating between the use of stone from primary and secondary deposits, new patterns for stone tool procurement and dispersal are proposed. Overall, metamorphic rock was the most common rock type encountered in the polished stone tool assemblages from the Neolithic sites in this region, these assemblages indicating a subsistence economy. A detailed morphological study of the finished and unfinished (blank) stone tools provided clues about their most likely sources of origin. A statistical analysis of the lithic material from the Hoca Çeşme, Aşağı Pınar, Aktopraklık, Hamaylıtarla and Kaynarca Neolithic sites provided insights into the life in these Neolithic societies.

Introduction

Archaeological studies worldwide suggest that metamorphic rocks were particularly favoured for tool making by prehistoric artisans because of their compact, hard and durable physical properties. These materials were often utilised because they allowed for various kinds of control in working and because the resulting tools were relatively reliable in experienced hands. To a large extent, the mechanical properties of the rock determined the range of techniques used to fashion particular tools. However, there were still choices to be made; in the specific technological steps taken during manufacturing and, more fundamentally, in the selection of raw materials from different kinds of source. This paper documents recent research on the production and dispersal of polished stone tools in North-western Turkey. In particular, it

is concerned with patterns of choice in the selection of raw materials for the making of polished stone axes; both the nature of the stone itself and its origin in either primary or secondary deposits.

Sites and materials

Also referred to as the Marmara Region (or Turkish Thrace), North-western Turkey comprises coastal areas surrounding the Black Sea, the Aegean and the Marmara Sea, and lands in north-western Anatolia (Fig. 1). Today, the area is bounded by the provinces of İstanbul, Edirne, Kırklareli, Tekirdağ, Çanakkale and Bursa. Across this area, a variety of sites provided material for this study. The earliest recorded evidence for polished stone tools in Anatolia comes from Hallan Çemi, in Southeast Anatolia

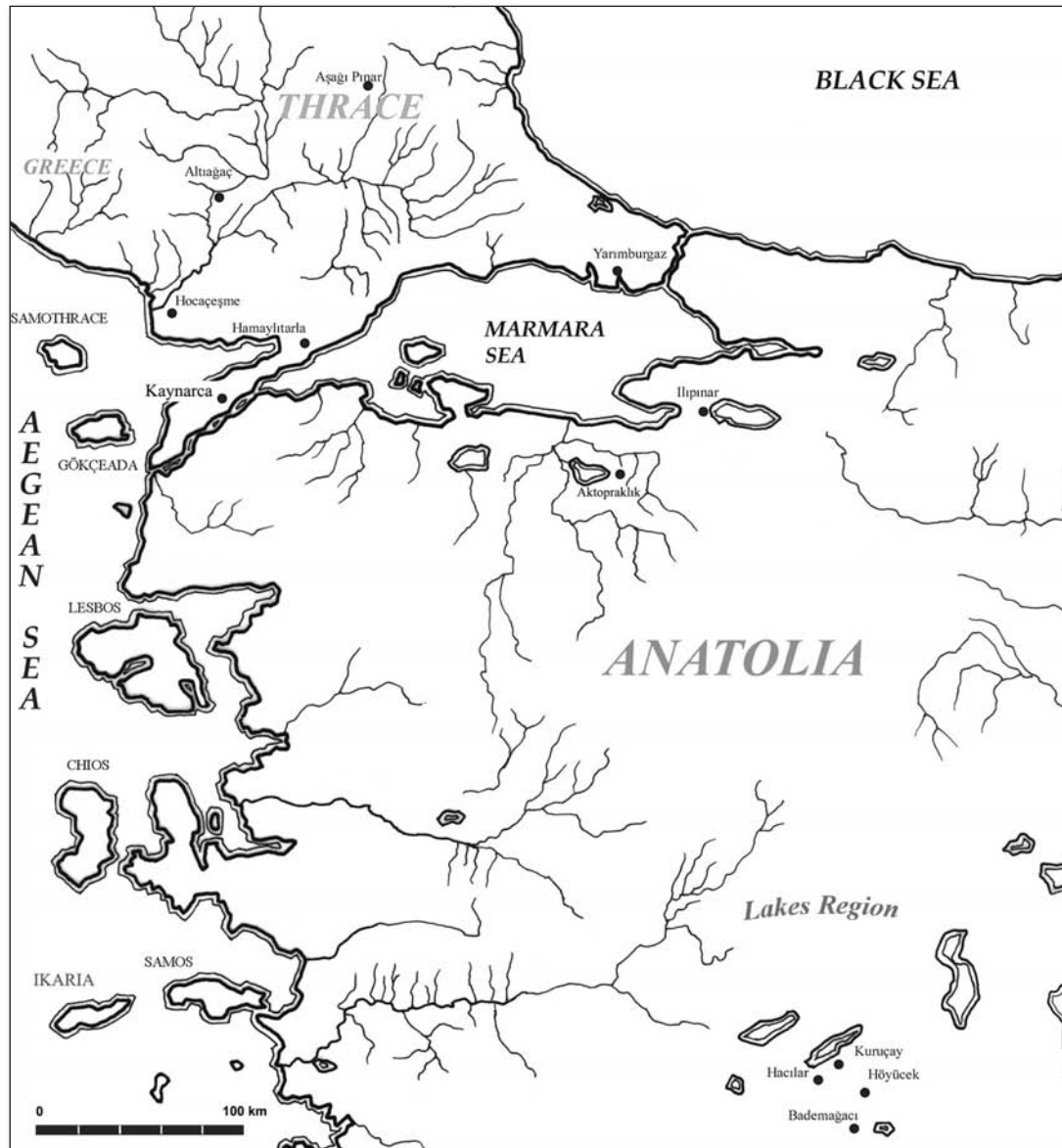
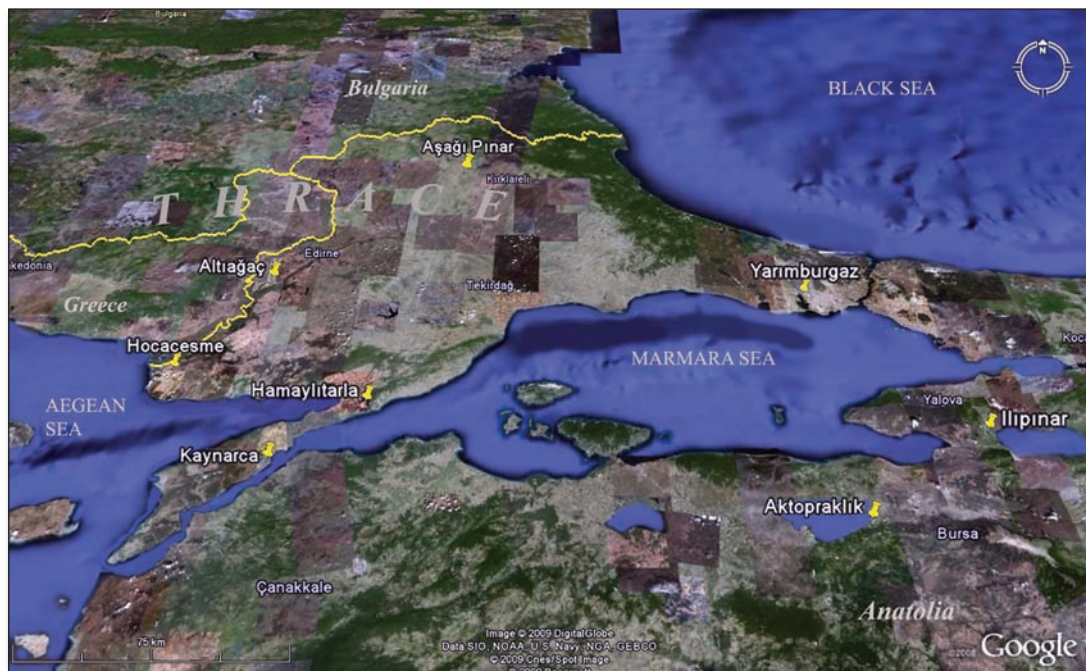


Fig. 1.
Map of north-west Turkey
with the mentioned
localities in the text.



Fig. 2.
Satellite view of Thrace
and location of the
prehistoric sites
(Source: Google).



(Rosenberg & Davis 1992). This well-published and well dated site provided good evidence for the first pre-ceramic cultures of Mesopotamia. Another relevant Neolithic settlement is Cafer Höyük, situated in the east of Anatolia, which has yielded polished tools dating to around 8000 cal BC. Some of the earliest examples of axes with antler sheaths (Cauvin *et al.* 1999; Cauvin & Aurenche 1982) were also found at Cafer Höyük.

Excavations of the layers dated 7500–6650 cal BC at the Yarımburgaz Cave near İstanbul, one of the better preserved Early Neolithic deposits in the region (Özdoğan *et al.* 1991), revealed one of the earliest occurrences of “cutting edge ground stone tools” in North-western Turkey. The Hoca Çeşme settlement near Enez (Edirne) has calibrated dates ranging between 6500–6000 cal BC, obtained from the basal layers (Özdoğan 1997; Karul 2000; Thissen 2002). This is Early Neolithic with respect to Balkan Chronology and Late Neolithic for Southwest Anatolia, where more sites and excavations are found in Burdur province, Lakes Region. İlipınar, near Bursa province has slightly later deposits when compared to Hoca Çeşme (6000–5400 cal BC). The Neolithic site of Aktopraklık Höyük near Bursa displays comparable cultural elements and relative chronology to the cultural layers of İlipınar V to VII (5500–5400 cal BC.) (Karul 2006, 2007) (Fig. 2). Aşağı Pınar is located about 150 km Northeast of Hoca Çeşme near the foothills of the Istranca (Strandzha) Mountains in the centre of the modern city of Kırklareli (Parzinger & Özdoğan 1996, Özdoğan *et al.* 1997, Özdoğan 1998,

1999). It is one of the best documented Neolithic–Chalcolithic period excavations in Turkish Thrace. The mound has cultural layers covering a period between 6000–4600 cal BC (Özdoğan 2007:420, 421).

The Kaynarca Neolithic settlement is situated centrally on a peninsula 7 km southwest of Gelibolu town (Fig. 2). The settlement site was found during a field survey (Özdoğan 1986) done by the Prehistory Department of İstanbul University, and more recently by Özbek (2008). Lichter (2005:62) proposes that Kaynarca may be a Late Neolithic settlement with West Anatolian cultural elements rather than Northwest Anatolian elements. According to the surface finds, pottery collected from the mound at Kaynarca seem to relate more closely to Western Anatolian Neolithic Cultures than to any of the other settlements in Thrace. It is also probable that the early Neolithic pottery tradition of Western Anatolia might have extended into the Gelibolu Peninsula by the mid point of the 7th millennium BC (Özbek 2008). In 1992, a survey team headed by Özdoğan collected Early Karanovo II wares from Altıağaç, another Late Neolithic mound near Edirne. Although not excavated, many polished stone tools were collected from the surface of the Altıağaç mound. These tools have been examined typologically as part of the broader general survey of the cutting edge polished stone tools of the Turkish Thrace Region (Özbek 2002).



Research design

The recognition that a considerable proportion of polished stone tools were manufactured from secondary sources prompted the investigation into possible reasons for the use of primary and secondary sources during the Neolithic of North-western Turkey. Macroscopic study of these tools confirms that some were manufactured from cobbles collected from river beds. The small negative depressions on the surfaces of these tools were diagnostic of their origins (Figs. 3, 4). Although most of the surfaces of these tools were ground and finely polished during the final stages of the 'chaîne opératoire', the manufacturers were either not concerned to completely remove the negative hollow areas, that it was not an economic use of time and energy; or that the tools were unfinished. The data supporting this particular observation derives not only from such sites as Aşağı Pınar, Hoca Çeşme, Ilıpınar and Aktopraklık, but also from Kaynarca and Altıtaş.

These patterns of procurement and production can be compared with the evidence from a probable 'workshop' at Hamaylıtarla. Reports on the site published during the past decade have highlighted the role and importance of raw materials and the dispersal of both unfinished and finished products (Özbek 2000a, 2000b; Özbek 2002; Özbek 2005) (Fig. 5). In the absence of sufficient excavation evidence it is too soon to say whether or not this was a seasonally-used or more permanent occupation site. What is clear is that the metamorphic rock outcrops near Hamaylıtarla provided both primary and secondary sources of material for stone tool making. The raw material could be obtained from the primary sources near Helva Tepe, and from rounded, water-worn cobbles in stream beds, often associated with weathered scree-slopes formed along tectonic fault planes (Fig. 6). In fact, rounded cobbles are thought to have been easier to work than rock obtained directly from outcrops. The permanent wetness of cobbles from secondary fluvial deposits may have also had an important impact on the working properties of the rock, especially during the flaking stages, when compared with the rocks that outcropped on the summits of the hills. Petrographic studies have demonstrated that the tools produced at Hamaylıtarla were distributed over a distance of at least 130 km – as far away as Aşağı Pınar Höyük (Özbek & Erol 2001).



Fig. 3.

Negative depressions on the surface of the polished stone tools: Altıtaş samples.

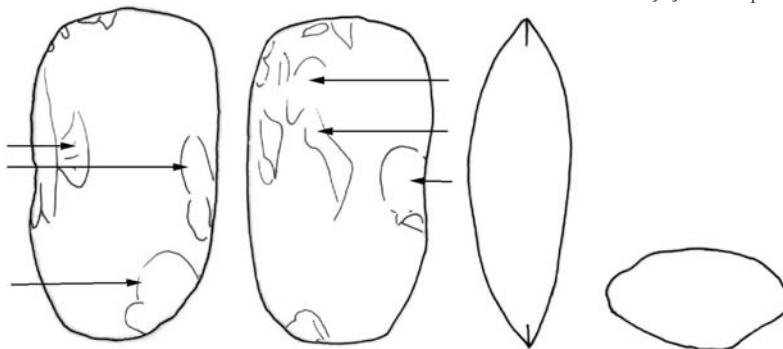
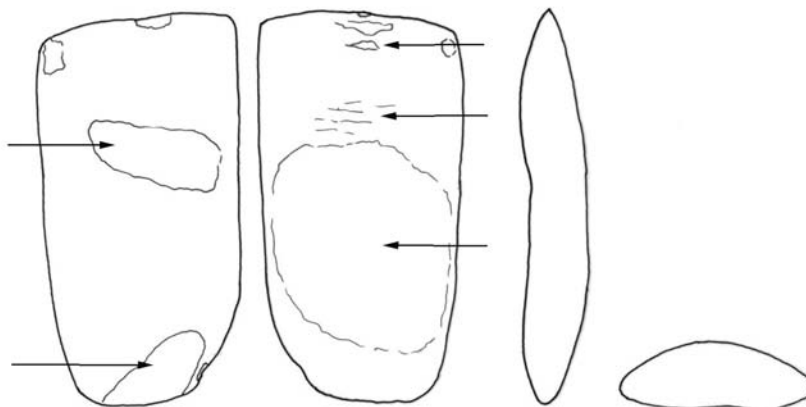


Fig. 4.

Negative depressions on the surface of the polished stone tools: Hoca Çeşme samples.

Hoca Çeşme # 92/5



Hoca Çeşme # 92/6 1.2.1

0 5cm





Fig. 5.
Examples of Hamaylıtarla
polished stone tool
production stages.

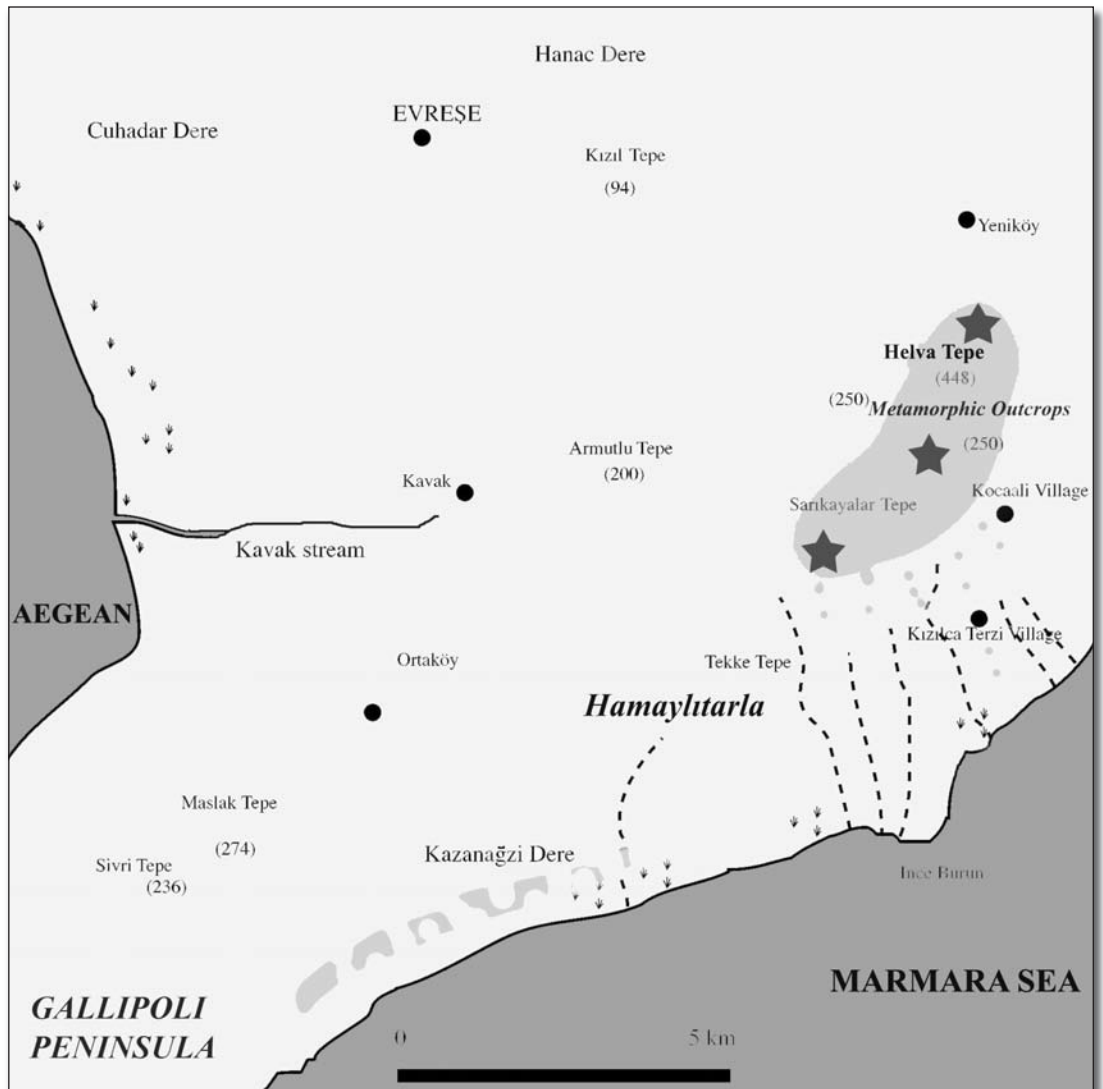


Fig. 6.
Concentration of Şarköy
metamorphic outcrops
between Helva Tepe and
Sarıkayalar Tepe.



Characterization and identification of sources

Research into the sources of polished stone tools which were manufactured from metamorphic rock outcrops in Turkish Thrace and Marmara, was focused on Turkey and Bulgaria. The outcrops of metamorphic rock near Şarköy were probably the most important sources during the Neolithic. However, two other potential sources areas were also considered. The first was an area of amphibolite outcrops to the south of Kardjali in Bulgaria (between Kromovgrad and Chernichevo, Avren) (Özbek forthcoming); the second was the Tavşanlı Zone in Kütahya (Okay 1982, 1984) (Fig. 7). Turkish sites near the Bulgarian border, such as Aşağı Pınar, might be expected to provide evidence of prehistoric exploitation of a range of lithic material. However, the petrographic analysis of material from the site, confirmed Şarköy as the principal source of polished stone tools (Özbek 2002).

In the case of Hoca Çeşme, the site is positioned between two outcrops of metamorphic rock – one in Bulgaria (Avren), and the other in Turkey (Şarköy): roughly 70–75 km apart. Although it was not possible to prepare thin sections for all of the material from Hoca Çeşme, the macroscopic descriptions strongly suggested that here again, Şarköy was the source of the metamorphic rocks (Özbek 2002). For Aktopraklık Höyük, studies are not yet available. It is too soon to discuss the petrographic significance of the utilisation of these metamorphic rocks and possible use of blueschists, which outcrop near Tavşanlı, c. 100km to the southwest (Okay 1982, 1984). Overall, at all the prehistoric settlement sites previously mentioned, metamorphic rocks that outcrop around Şarköy were the most widely exploited source for Neolithic tool making across the region.

Metamorphosed blueschist-facies and greenschist-facies rocks outcrop 14 km west of the modern town of Şarköy. These massive



Fig. 7.
Three important
metamorphic outcrops
with massive raw material
situated between
Europe and Asia.
(Map adapted from
Olivier Weller)



Ref.#	Locality	Coordinates N&E	Rock type	Minerale compound	Petrographic texture	Petrographic features
SK 1	Sarıkayalar Tepe/Tekirdag	40 36 28 – 26 58 44	Tremolite/ Actinolitefels	Act+Tre+relic Hb±Qu±Chl±Ti± Lvs± Opaque min.	Nemato-fibroblastic	Fels texture
SK 1B	Sarıkayalar Tepe/Tekirdag	40 36 28 – 26 58 44	Tremolite/ Actinolitefels	Act+Tre+relic Hb/Pr±Chl±Qu±Ti	Nemato-fibroblastic	Titanite formations, leucoxene formations and opacity beginning from ilmenite
SK 2	Sarıkayalar Tepe/Tekirdag	40 36 30 – 26 58 59	Metabasite	Tre/Act+relic Hb / Pr+Qu±Gln±Ti	Nemato-fibroblastic	Tremolite, actinolite and partly glaucuphane formations from pyroxene & hornblende
SK 2B	Sarıkayalar Tepe/Tekirdag	40 36 30 – 26 58 59	Tremolite/ Actinolitefels	Act+Tre+Qu+relic Hb & Pr±Ti	Nemato-fibroblastic	Relic minerales are prominent
SK 3A	Sarıkayalar Tepe/Tekirdag	40 36 25 – 26 58 56	Tremolite/ Actinolitefels	Act+Tre+relic Hb±Ti	Nemato-fibroblastic	great part in tremolite/actinolite
SK 4	Sarıkayalar Tepe/Tekirdag	40 35 14 – 26 57 35	Tremolite/ Actinolitefels	Act+Tre±Qu±Ab±Ti	Nemato-fibroblastic	Fully tremolite/actinolite, no trace of rock origin
SK 5A	Sarıkayalar Tepe/Tekirdag	40 35 45 – 26 57 49	nondescript	Ep?+Klinoklor	nondescript	nondescript
SK 6	Sarıkayalar Tepe/Tekirdag	40 35 56 – 26 57 46	Metabasite	Act/Tre+relic Pr / Hb+ Qu±Gln±Lvs±Ep±Ti	Nemato-fibroblastic	Glaucophane formations
SK 7	Sarıkayalar Tepe/Tekirdag	40 35 50 – 26 58 12	Metabasite	Act/Tre+relic Pr / Hb±Gln±Ti	Nemato-fibroblastic	Origin rock mineralogy is mostly preserved, glaucophane formations evident
SK 8	Sarıkayalar Tepe/Tekirdag	40 35 42 – 26 58 28	Metabasite	Tre/Act+relic Pr & Hb+Qu ±Gln±Ti	Nemato-fibroblastic	nondescript
SK 9	Sarıkayalar Tepe/Tekirdag	40 35 32 – 26 57 58	Metabasite	Tre/Akt+relic Pr / Hb+Ep±Ti	Nemato-fibroblastic	nondescript
SK 10	Sarıkayalar Tepe/Tekirdag	40 35 26 – 26 57 36	Metabasite	Tre/Act+Hb+Pr±Gln±Kl±Ti	Nemato-fibroblastic	alterations starting from relic minerals
KN 1	Konga Dere/ Tekirdag	40 36 18 – 26 59 36	Tremolite/ Actinolitefels	Tre+Act+relic Pr & Hb± Qu±Kl±Ti	Nemato-fibroblastic	generally formed of fine grained minerals
KN 1A	Konga Dere/ Tekirdag	40 36 18 – 26 59 36	Tremolite/ Actinolitefels or Metabasite	Tre/Act+relic Pr / Hb+Qu±Gln±Ti	Nemato-fibroblastic	relic minerals are abundant, starting from these very weak glaucophane formations
KN 2	Konga Dere/ Tekirdag	40 36 21 – 26 59 24	Metabasite	Act+relic Hb & Pr±Qu ±Ti	Nemato-fibroblastic	green actinolite formations are clear
KN 2A	Konga Dere/ Tekirdag	40 36 21 – 26 59 24	Metabasite	relic Pr & Hb+ Chl+Tre/Act+Qu±Ti	Nemato-fibroblastic	Abundant relic minerals and chlorite formations, no metamorphic orientation texture
KN 6	Konga Dere/ Tekirdag	40 36 02 – 27 00 15	Tremolite/ Actinolitefels	Tre/Act+relic Hb+Qu+Plg	Nemato-fibroblastic	Plagioclase formations in the rock in thin veins
KN 7	Konga Dere/ Tekirdag	40 36 21 – 27 00 31	Metabasite	relic Pr & Hb+ Tre/Act±Gln±Ti	Nemato-fibroblastic	ample relic minerals, weak galucophane formations, fine grained mineral
KN 8	Konga Dere/ Tekirdag	40 36 30 – 27 00 44	Tremolite/ Actinolitefels or Metabasite	Tre/Act+relic Hb/Pr+Qu±Ti	Nemato-fibroblastic	nondescript

Table 1.

A result of Yeniköy tectonic melange: mineralogical compositions of the Sarıkayalar and Konga Dere rocks.

Abbreviations

Tre: tremolite;

Act: actinolite; Ab: Albite;

Ep: epidote; Ti: titanite;

Pr: pyroxene; Qu: quartz;

Hb: hornblende;

Gln: glaucophane;

Zoi: zoisite; Chl: chlorite;

Lvs: Lawsonite;

Plg: plagioclase.

exposures of the blueschist rock belong to the Yeniköy Tectonic Melange (Upper Cretaceous), and are linked with recent activity along the “North Anatolian Fault” (2004:51), only some few km away from Hamaylitarla. The rocks are fine-grained, unbedded, hard, compact and durable (Fig. 6). The rocks have been described as glaucophane-lawsonite schist, tremolite/actinolitefels, epidote-chlorite schist and serpentinites (Table 1). Terminology can be confusing: in order to characterize the diabase in its unique transformation phase, geologists Yavuz Erkan and Kenan Erol identified these rocks as ‘nephrite’ (see Erol 2003). However, the use of the term “nephrite” in the Thracian setting,

does not equate with jade or ‘sodic pyroxene’ for the implements.

Research in Turkey over the last 30 years in Turkey, notably by the MTA in Ankara, has identified other outcrops of metamorphic rocks which may have attracted the attention of Neolithic stone tool makers (Table 2). However, only some of these outcrops may have provided material as suitable for tool making as the hard, durable, compact (massive) high density metamorphic rocks of Şarköy.



METAMORPHIC ROCKS FROM DIFFERENT LOCATIONS IN TURKEY				
No.	Lab No.*	Rock name or composition	Location of the geological sample	Province
1	22158	glauconite schist	Altintepe Sivrisi, Marmaris	Muğla
2		albite amphibolite	Akpınar	Muğla
3	21835	albite quartz chlorite amphibolite	Çelikeliköy, Marmaris	Muğla
4	22039	albite epidote amphibolite	Bozburun, Marmaris	Muğla
5		albite glaucophanite	Çetinbelli	Muğla
6	21948	albite amphibolite	Gölyeri, Marmaris	Muğla
7	198	pyritized foliated biotite muscovite quartz schist	Hizan	Bitlis
8	22196	quartz chlorite epidote actinolite schist	Göktepe, Kavaklıdere, Yatağan	Muğla
9	22163	amphibole epidote chlorite schist	Kabir, Köyceğiz	Muğla
10	21887	chlorite albite glaucophane schist	Çileklitepe, Marmaris	Muğla
11	21188	diopside amphibolite gabbro amphibolite	Kızıldağ, Zara	Sivas
12	22217	glauconite quartzite	Karadere, Ula	Muğla
13	21989	amphibole garnet quartzite	Göktepe, Marmaris	Muğla
14		albite crossite	Karabörtlen	Muğla
15	21860	muscovite albite amphibolite	Akçapınar, Marmaris	Muğla
16		muscovite crossite quartzite	Bolkardağı, Maden, Ulukışla	Niğde
17	53025	eclogite	non defined	Muş
18	403	actinolite fels	Karaköy, Bayramiç	Çanakkale
19	23853	actinolite fels	Çelebi, Keskin	Ankara

Raw material preferences on excavated sites

Eighteen out of the 78 implements (23%) analysed from the Hoca Çeşme Neolithic assemblage were polished stone tools which showed evidence of manufacture from secondary sources. They were made from cobbles obtained from the river banks or along dry stream or river beds (Table 3). Listed in the general Hoca Çeşme small find inventory were three water-worn cobbles, apparently taken to the settlement because of their natural resemblance to the required axe/adze form. Obviously, the evidence of three natural 'axe blanks' alone, does not constitute sufficient evidence for a specific workshop in the settlement. For this to be accepted, we would expect to see additional material such as blocks, nuclei and flakes and all these elements of the 'chaîne opératoire' are missing from Hoca Çeşme.

Twelve polished stone tool fragments from Hoca Çeşme were thin sectioned and characterised using a petrological microscope. Serpentine was the dominant preferred raw material for the manufacture implements, followed by nephrite. The most commonly occurring minerals in the nephrite tools were actinolite, tremolite, zoisite, albite, feldspar, titanite, and relict pyroxene and hornblende. Therefore, the petrography of these rocks was very similar to metamorphic rocks that outcrop

near Şarköy. The third, and less frequently preferred group of materials at Hoca Çeşme were sedimentary rocks. These may have been obtained from secondary sources, for example from the Aegean Sea coast and the large delta of the Maritsa River (Meriç). Geological maps of the Drift deposits to the West and Northeast of this area, indicate the existence of secondary sources, potentially suitable for stone tool making, only a few kilometres from the settlement. These include siliceous rocks such as chert, cryptocrystalline quartz (jasper) and quartz cobbles, all of which can be found along the Meriç River, only 3–4 km to the west (Fig. 8).

At Aşağı Pınar, 28 out of 321 polished stone axes (9%) retained features characteristic of an origin in secondary sources broadly similar to those seen at Hoca Çeşme, where the basal layers of the latter are c. five centuries older. Although the percentages here are low when compared to Hoca Çeşme, we should bear in mind that only those artefacts with clear evidence for the use of secondary sources were

Table 2.

Some locations in Anatolia with glaucophane schist, amphibolite, actinolite fels and eclogite occurrences according to MTA Institute Museum, Mineralogy Section in Ankara.

* Ref Nos are from Natural History Museum of MTA Institute in Ankara.

Table 3.

Blank origins of the polished tools from different excavations and sites in north-western Turkey.

BLANK ORIGINS				
	Hoca Çeşme	Aşağı Pınar	Aktopraklık	Altıağaç
Tool Number	78	321	122	18
Support (bloc)	(?)	(?)	2	(?)
Support (cobble)	18	28	26	5
Cobble (%)	23	9	21	27



Fig. 8.

Various secondary stone sources for the Neolithic Hoca Çeşme settlement: sea shore, river beds, down slopes of the hills (source: Google).



taken into account in our analysis. Due to the overall polishing of many pieces, source identification was often not possible, so it may be that the contribution of secondary deposits such as river beds was significantly higher (Fig. 8). Also noteworthy is a marked increase in the frequency of tools in Aşağı Pınar Layers 4 and 5. At Hoca Çeşme the highest frequencies are found in Layer 1 (a, b, c, d) and to some extent Layer 2 (architectural phase I) dated to 5500–5000 cal BC (Özbek in press).

A total of 122 lithic fragments were found between 2006 and 2008 at the Aktopraklık settlement, of which 26 (21%) were polished stone tools made from cobbles of fluvial origin. Ten (8%) were hammer stones or anvil stones associated with the manufacture of stone axes and adzes. A high percentage of the total number of the stone tools studied macroscopically resembled Şarköy metamorphic rock. These rocks outcrop at a distance of 150 km, and are separated from the settlement site by a significant natural barrier that divides Asia from Europe (Fig. 7). Further petrographic analyses and geoarchaeological fieldwork will be needed in order to identify more securely the source outcrop(s) for this group.

Discussion

Models seeking to describe and explain the exploitation, manufacture, use and deposition of stone tools by prehistoric societies have been proposed from many different countries and across a chronological range from the Palaeolithic to the Classical period. In many of these, the terms “exotic” and “local” are widely used.

Such distinctions may be valid; the sources of stone probably mattered to prehistoric communities in lots of different ways. However, we must be cautious in using such terms, not least because they have clearly meant different things to different authors. For example, in his study of a 10,000 year old rock shelter in the Australian Desert, Gould (1977:123) uses the word “exotic” to describe raw material sources situated more than 40 km from the site. By contrast, in a study of obsidian sources and hunter-gatherer mobility in North America, Roth (2000: 306) describes the raw materials gathered c.100 km away from the site as “non-local”. Minichillo (2006:360), in a study on MSA African stone tools, uses the term non-local to describe raw material originating 25–50km away, arguing that its occurrence can indicate several different things; foraging distance, procurement expeditions or even long-distance trade. For Minichillo, “exotic” is an informal term that simply means the raw material is locally rare, and may have been obtained from a distant and sometimes unknown source. Elsewhere, Lavin and Prothero (1992) were able to differentiate between primary and secondary chert sources in North America, with implications for local and distant dispersals. Shockey’s studies (1995), which distinguished between cherts from primary and secondary sources, also merit attention. All of this work indicates that whilst distinguishing between primary and secondary sources, and between local and more distantly derived material, may be important, the interpretation of archaeological patterns is by no means straightforward.

More recent studies of European Neolithic polished stone tools indicate that the utilisation



of secondary sources is not unusual (Harrison & Orozco Köhler 2001; Orozco Köhler 1997; Maluquer 1979; Valdes 1981) – a view shared by specialists in geoarchaeology and prehistory in France (e.g. Ricq de Bouard 1996). Stroulia (2003) has also discussed issues affecting the choice between the same raw material from different primary and secondary sources from Franchthi Cave in the southern Argolid peninsula in Greece. In Northwest Turkey, the preference for primary rather than secondary sources involved choosing between materials that could be found nearby and those whose exploitation required the negotiation of considerable distances (Table 4). At Hoca Çeşme for example, the roughouts of the polished cutting edge tools generally came from a primary source at Helva Tepe (Fig. 9). The tools which originated from secondary deposits, for example the beds of small rivers and brooks, were manufactured from such rocks as serpentinite and, to a lesser extent, gneiss and schist (Fig. 10). On the other hand, the bigger tools of regular, symmetrical shapes were usually produced from the best raw material available; metabasites or nephrites. The smallest tools, such as chisels and wedges were usually made from serpentinite. This suggests that for functional reasons, the tools which were best suited for heavy work were made from metabasite, which was obtained from more distant sources. The case is similar to the situation at Aşağı Pınar where the best raw material suitable for the production of heavy work tools occurred c. 130 km away from the settlement. In other words, we can see a relationship between the properties of particular materials, the distances over which they moved, and the intended functions of different kinds of tool.

Recent research by the author suggests that the origin of the high quality metamorphic and blue-schist rocks used for tool making at sites on the Asian side of the Marmara Sea, at Aktopraklık Höyük near Bursa, seems to be near Kütahya-Taşanlı (see for example Sherlock *et al.* 1999; Önen & Hall 1993; Okay 1982) (Fig. 7). However, the preliminary results of the petrographic analyses of Aktopraklık polished tools are not yet available to confirm or refute this observation. It is also interesting to note that the proportions of the water-worn cobbles reported from Aktopraklık (21%) are similar to those seen at Hoca Çeşme (23%).

The selection of raw material for making sharp, heavy and large polished cutting tools was mainly confined to metamorphic rocks without oriented mineralogical textures. In contrast, the well manufactured large-sized pol-

Sites	Flake abundance	Blanks	Cobbles	Blocs	Distance from nearest source (~ km)
Hoca Çeşme	Rare	Rare	23%		70
Aşağı Pınar	Rare	Rare	9%		130
Aktopraklık	Rare	Rare	26%		100
Hamaylıtarla	High	Mostly	n/a	Abundant	1 to 5
Kaynarca	Few	Rare	n/a		35
İlipınar	Rare	Rare	Present		100
Altıtaş	n/a	Rare	27%		70

ished stone tools from the Hoca Çeşme settlement site were typically made from nephritite; a result of blueschist facies metamorphism (Özbek forthcoming). However, the metamorphic rocks of the Istranca Massive in the northern Thrace have completely different textural and mineralogical features. These rocks were mostly belonging to greenschist and amphibolite metamorphic facies, which consist mainly of various schists, gneisses and amphibolites. There is no obvious petrographic similarity between the ground stone tools and these rocks (Şengün 1993). Also, there are considerable outcrops of sedimentary sequences in central Thrace, the use of which for stone tool making is presently unknown. Most recent research, therefore, suggests that the raw material sources most favoured for polished stone tool production in the south-west Thrace were the outcrops of the Yeniköy Melange metamorphic rocks.

It is also worth noting the hammer stones directly related to the production of polished stone tools. These were generally collected from stream beds adjacent to the sites. According to the excavation data, the raw material of these ‘tool making tools’ was usually quartzite, which occurred abundantly across a vast areas of metamorphic terrain, and varied up to large boulders in size, especially in North Marmara region. Hence, quartzite was readily available on the dry river beds and sometimes on the

Table 4.
Comparison of *chaîne opératoire* elements and distances to hypothetical raw material sources (Hoca Çeşme, Aşağı Pınar and Hamaylıtarla are confirmed sources).

Raw material procurement at Hoca Çeşme	
Distance between raw material and workshop	~70 km Workshop found near Şarköy
Raw material – end product distance	~70 km
Quarry techniques	Open quarry? Screes and river beds as sources?
Raw material choice	High Pressure (HP)/ Low Temperature (LT) metamorphic rocks Blue schist facies Present (sawing of the end product)
Raw material economy	

Fig. 9.
Raw material procurement at Hoca Çeşme.



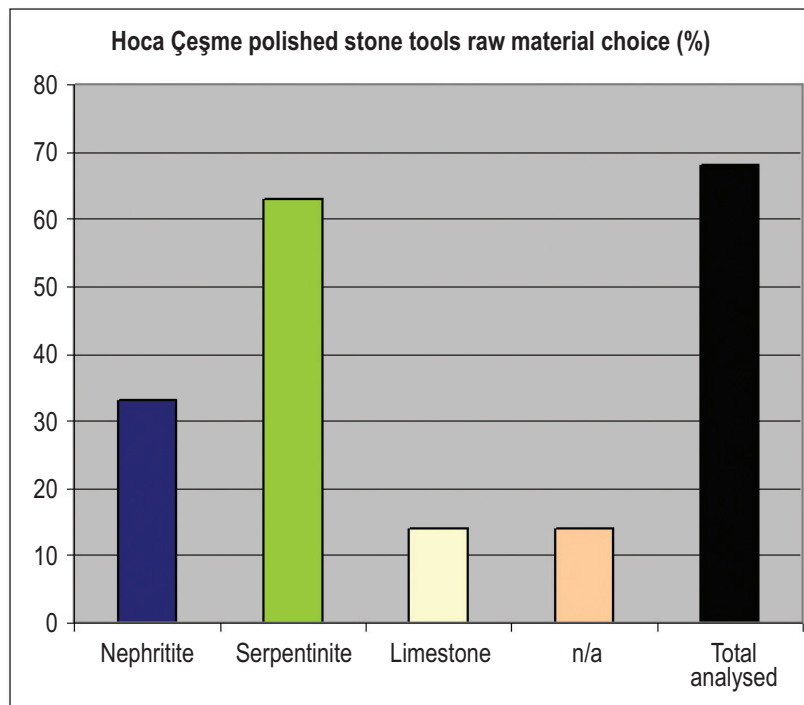


Fig. 10.
Raw material choice
in the production of
Hoca Çeşme polished
stone tools.

beaches of these river bends (e.g. north of Kırklareli near Aşağı Pınar).

While these patterns invite various interpretations, there is still much empirical research to be done before many questions can be answered. Of these, some of the more immediately important concern the mechanisms by which material was moved over considerable distances; the nature and extent of exchange systems and, inevitably, the significance of stone axes themselves. The question of whether or not any of the polished stone axes in this study had a social or symbolic significance similar to that argued for other regions has never been asked in Turkey. If that significance is inferred from singular factors like the size of blades (e.g. more than 15cm in length), then it must be said that there is little evidence at present, though this is perhaps a consequence of a lack of systematic study. At present, there is very little obvious evidence for large non-utilitarian Neolithic polished stone tools in Anatolia and even less in the Northwestern part of Turkey considered here. There is only one example, a finely shaped nephrite axe from Hoca Çeşme, which exceeds 20 cm in length. A second example is a very skilfully manufactured polished axe exhibited in Kırklareli Museum, which is more than 25 cm in length. Nonetheless, macroscopically, this artefact seems to have been made from metabasite, an observation which will need to be confirmed, or otherwise, by non-destructive analysis. Of course, it may well be that the significance of axes was not always defined by or reflected in their size. Under these

circumstances, it will require much more detailed and systematic analysis of materials, distributions, treatment and context before we can address this concern.

Concluding remarks

This paper has presented a first review of the petrographic and archaeological evidence for the production and dispersal of ground and polished stone tools from North-western Turkey. It is more than probable that the metamorphic rock outcrops on the foothills of Ganos Mountains near Şarköy (Tekirdağ) was a significant source of rock used for stone tool manufacture during the Neolithic across a wide geographic area. To understand the outer limits of this zone of exploitation and dispersal, and the associated rock sources in the Balkans and Thrace regions, will require further petrographic characterisation studies. However, evidence from the excavations at Hoca Çeşme, Aşağı Pınar and Aktopraklık, is already adding much to our understanding of Neolithic societies in North-western Anatolia and Turkish Thrace. Generally speaking, the polished stone tools with cutting edges from archaeological contexts were produced from a range of rock types. Although, the smaller tools were generally produced from rocks obtained from secondary sources, the bigger tools, which would have been utilised for heavier tasks were made using harder, stronger and more massive rock types such as metabasite and diabase. According to present geological and archaeological information available for this region, the main source of these rocks is near Şarköy town in Tekirdağ Province. Macroscopically, after grinding and polishing, these rocks have fine grain; dark colour and smooth surface. They were not particularly attractive visually, but were most probably preferred for their manufacture and working properties. Thus, stone tools made for performing comparatively heavy tasks were manufactured from rock selected especially, and transported, from distant primary sources. Comparatively large artefacts have not yet been identified from the region, suggesting an absence of stone implements as prestigious, non-utilitarian objects. More implement petrology research is needed in order to propose and understand new models of procurement and dispersal networks. These data will be vital if we are to understand the social value or significance of stone tools, particularly those made from Şarköy metamorphic rocks.



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Stone-working traditions in the prehistoric Aegean:

The production and consumption of edge tools at Late Neolithic Makriyalos

Abstract

Stone axes have received a lot of attention in northern European Neolithic studies, with work on raw material sourcing, production, use, exchange, deposition and symbolism. By comparison, and with a few important exceptions, stone axe studies in the prehistoric Aegean have been more limited in scale and scope focusing mainly on typological and techno-morphological issues. This paper uses the evidence from the Late Neolithic site of Makriyalos to explore the technological and social significance of axes and related edge tools in Northern Greece. Linking raw material characterization to a critical characterization of the chaînes opératoires of the Makriyalos edge tools reveals that these were far from mundane artefacts. In fact, they were the result of complex choices, informed by cultural understandings of appropriateness, which conditioned the selection of stone, the manner of use and the character of deposition.

Introduction

Stone axes have received a lot of attention in northern European Neolithic studies, with work on raw material sourcing, production, use, exchange, deposition and symbolism (cf. Clough & Cummins 1979; Bradley *et al.* 1992; Leighton 1992; Bradley & Edmonds 1993; Edmonds 1995, 2004; Ricq-de Bouard 1996; Cooney & Mandal 1998; Pétrequin *et al.* 1998; Cooney 2002; Skeates 2002). By comparison, stone axe studies in the prehistoric Aegean have been more limited in range and scope focusing mainly on typological and techno-morphological issues (see however Stroulia 2003). This paper uses the evidence from the Late Neolithic site of Makriyalos to explore the technological and social significance of axes and related edge tools in Northern Greece.

One of the first classifications of axes, adzes and chisels (all collated under the term 'celts') was offered in the pioneering work of Tsountas (1908), a scheme that influenced many subsequent studies in Greece (e.g. Mylonas 1929; Sugaya 1993). Following that, Moundrea-Agrafioti's work on edge tools from Neolithic Thessaly (1981; 1996; Moundrea-Agrafioti & Gnardellis 1994) sought to establish a classification scheme based on associations between raw materials, manufacturing techniques, dimensions and shapes of artefacts. Similarly, use-wear analysis on the edge tool assemblage from Sesklo led Christopoulou (1992) to suggest the existence of three functionally distinct categories of tools. This work has been very important. However, it is probably fair to say that research on edge tools has often dealt with a fairly restricted set of issues. More often than not, questions of function and efficiency in use have been emphasised to the exclusion of other themes (Perlès 1992). Overall, we have tended to assume that these tools were predominantly utilitarian in character. As a result, we have asked questions very different from those we ask of other material culture, such as mace-heads, ornaments and vessels regarded as "... *valuable because of their rarity, the skills and time required for their manufacture, and the quality of the raw material selected...*" (Perlès 2001:285; cf. 1992:144). We only break from this pattern where the edge tools under study are especially unusual or distinctive (e.g. the long polished axes from Nea Nikomedeia).

Given these issues, it may be better to take a more fully contextualised approach, which uses the details of production and consumption to explore the particular significance that these artefacts held for Neolithic communities. Until

recently, this has been easy to advocate but not all that easy to do, primarily because of the small size of many assemblages. For example, only 58 edge tools were recovered from Neolithic contexts at Achilleion (Winn & Shimabuku 1989), and there were less than 100 from Franchthi (Perlès 2001:231; Stroulia 2003). However, the much larger assemblage of 1893 edge tools (axes, adzes and chisels) recovered from the Late Neolithic settlement of Makriyalos provides a rare and welcome opportunity to study the *chaînes opératoires* of this class of artefacts in great detail. By characterising the kinds of choices made in procurement, production, use and deposition/discard, it becomes possible to infer something of their significance, both at Makriyalos and more broadly across the Aegean Neolithic.

The site and the assemblage

Makriyalos is one of the largest flat-extended Neolithic settlements in Macedonia, Greece (Fig. 1) (Kotsakis 1999; Pappa & Besios 1999). It covers an estimated area of c.50 hectares, six hectares of which have been excavated. Two phases of occupation, both dated to the Late Neolithic, are distinguished: Makriyalos I, attributed to the early LN (5200–4900 cal BC) and Makriyalos II, to the late LN period (4900–4500 cal BC). Architectural elements include two ditches enclosing the settlement of the first

Fig. 1.
Map of Greece
showing the location
of LN Makriyalos in
northern Greece.



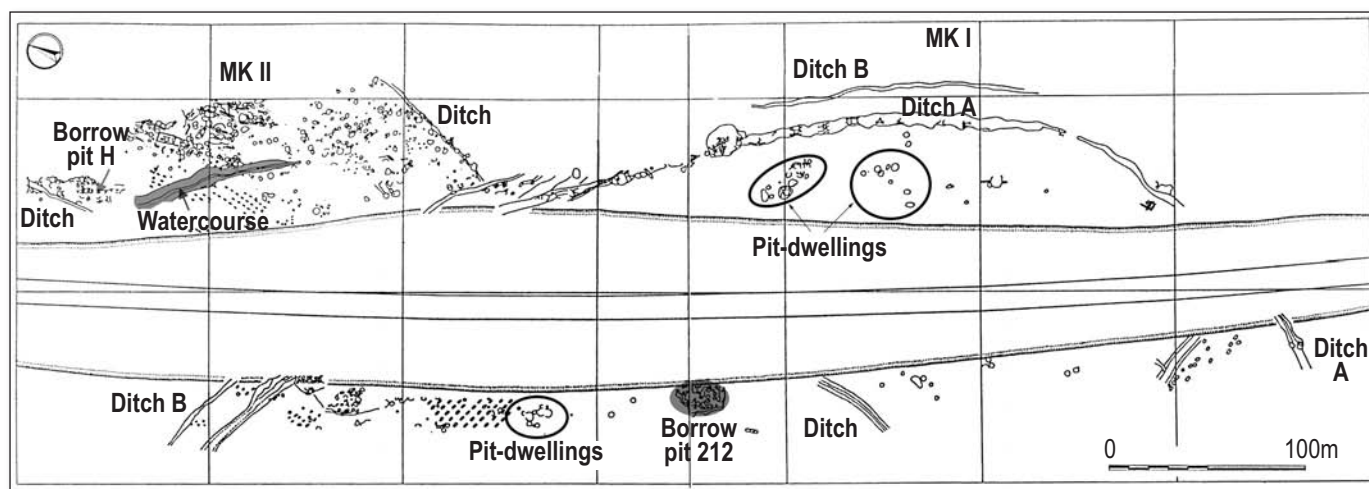


Fig. 2.
Plan of LN Makriyalos
showing main features
of phase I and II
(after Besios and
Pappa 1998a).

phase, a third ditch within this enclosure, pit-dwellings attributed to both phases, and rectilinear buildings from Makriyalos II (Pappa 2008). Large borrow-pits with evidence from possible feasting episodes were also discovered in Makriyalos I (Fig. 2) (Pappa *et al.* 2004).

The Makriyalos edge tool assemblage comprises 1893 tools in total and represents to date the largest such assemblage from Neolithic Greece, as is also the case for other material categories and bioarchaeological assemblages from Makriyalos. The large size of the assemblage partly reflects the size of the excavated area but also the recovery of contexts exceptionally rich in finds (Pappa *et al.* 2004:18). The size of the population at Makriyalos, similar to other flat-extended settlements, is unknown but the volume of material unearthed from pit 212 suggests that feasting events took place that involved a large number of people potentially extending far beyond the local community (*ibid.*).

The edge tools can be divided morphologically into axes, adzes and chisels. The concurrent use of axe- and adze-shaped tools at Makriyalos is a pattern repeated across south European lithic traditions (Perlès 2001:234). Edge tools were recovered from both phases of occupation and all types of contexts (habitation pits, communal ditches and borrow-pits). Detailed spatial and contextual analysis suggested that during the first phase of occupation edge tools were associated mainly with habitation areas as is also the case for highly polished tools during Makriyalos II (Tsoraki 2008). Edge tools from these contexts exhibit great similarity in terms of manufacturing techniques, extent of use and degree of polishing. The wear on tools from habitation contexts ranges from light chipping to heavy chipping while in some cases the cutting edges have become blunt. This suggests that they could

have been used for a variety of tasks, such as light and heavier woodworking, animal skin processing, butchering, bone working, or digging (Blackwood 1950:23; Edmonds 1995:53; Perlès 2001:232). Both in Makriyalos I and II habitation areas different rocks are evenly distributed; this possibly suggests unrestricted access to both local and non-local resources by all members of the community. This might be seen as a means of maintaining a sense of shared identity and belonging, allowing for social cohesion.

Raw materials, sources and the appropriateness of rocks

The Neolithic community of Makriyalos employed a wide variety of rock types for their stone tool technology (c. 25 rock types). These can be attributed to all three geological categories (metamorphic: 41%, sedimentary: 37% and igneous: 18%). This variability reflects to a certain extent the location of the site in a diverse geological area. Makriyalos is located in the Vardar (Axios) isopic zone which lies between the Serbo-Macedonian massif to the east and the Pelagonian zone to the west (Higgins & Higgins 1996:17–18). Makriyalos and its immediate vicinity are characterised by alluvial deposits (Higgins & Higgins 1996:108), formed by rivers and streams that drain the Pieria Mountains, located c. 25 km to the west. This mountain range is characterised by ophiolites, phyllites, schist-gneiss and limestones, marble and dolomites (Higgins & Higgins 1996:109; IGME 2002). The ophiolitic complex is characterised by serpentinized and weathered ultrabasic-basic rocks such as dunitic serpentinite, and, at the margin of the ophiolites, dolerites and to a lesser extent diorites and microgabbros. Volcanic rocks are not widely dis-



tributed in the Vardar zone and the province of Macedonia in general (Higgins & Higgins 1996: 107, Fig. 11.1; Pe-Piper & Piper 2002). Hence, their presence within the Makri-yalos ground stone assemblage (see below) suggests rather different procurement strategies to those employed for the acquisition of metamorphic and sedimentary rocks.

The presence of un-worked nodules with waterworn/weathered surfaces in the Makriyalos ground stone assemblage points towards the procurement of material from secondary deposits (e.g. river beds). There is limited evidence, however, for the employment of quarried serpentinite. Procurement of serpentinite through quarrying has also been suggested for the stone axe assemblage from Neolithic Dispilio, Macedonia (Stratouli 2002).

This suggests that procurement from both primary and secondary sources was practised at Makriyalos, a variety that would have allowed distinctions to be drawn in terms of access, organisation and, perhaps, the significance of working. The method of raw material procurement (outcrops or secondary deposits) may have even been linked to the subsequent use and treatment of the final products as has been suggested by Pétrequin *et al.* (1998:282) for polished blades in Irian Jaya. The procurement of rocks from river beds has been regarded as an 'efficient' alternative to quarrying, requiring less time and effort. Nonetheless, the presence of different qualities of rocks within the same river makes the process of finding good quality material a time-consuming, difficult task that requires great experience and knowledge of the landscape and the processes that constantly transform it (cf. Hayden 1987; Risch 2008). Hence, even when people choose their material from stream beds, there is always a selection process in place and a dialectic relationship between them and their surrounding landscape.

Interestingly, the analysis of the Makriyalos ground stone assemblage suggests the preferential use of certain raw materials for the production of different object categories (Tsoraki 2008). Edge tools were fashioned mainly from metamorphic (50%) and igneous rocks (49%), and only rarely from sedimentary ones (1%). Among metamorphic rocks there is a clear preference for serpentinite, which was used for 41% of the edge tools, a common aspect throughout the Greek Neolithic (cf. Moundrea-Agrafioti 1996:104; Perlès 2001:232). Igneous rocks are mainly represented by dolerite (13%), basalt (7%) and generally fine grained varieties of igneous rocks (together 15%) (see Table 1).

	Raw material	No.	Percent
Sedimentary	Well cemented sandstone	17	1.0
	Dolomite	1	.1
	Flint	1	.1
	Total	19	1.2
Metamorphic	Serpentinite	686	40.9
	Schist	41	2.4
	Gneiss	1	.1
	Marble	7	.4
	Slate	1	.1
	Granulite	1	.1
	Indet. Metamorphic	99	5.9
	Total	836	49.8
Igneous	Granite	1	.1
	Gabbro	59	3.5
	Granodiorite	1	.1
	Diorite	71	4.2
	Dolerite	215	12.8
	Basalt	115	6.8
	Andesite	79	4.7
	Andesite-Basalt	56	3.3
	Lydite	1	.1
	Indet. Igneous	226	13.5
	Total	824	49.1
	TOTAL	1679	100.0

Table 1.

Raw material use for edge tools (excluding indeterminate raw materials, n=214).

The Makriyalos community also favoured different rock types for different categories of edge tools. The traditional assumption, that axes were used for heavy chopping tasks (e.g. tree felling) (cf. Adams 2002:166), adzes for working a range of materials, and chisels for finer carpentry, has recently been challenged by the counter-suggestion that all three 'types' were indiscriminately used for an overlapping range of functions (e.g. Moundrea-Agrafioti 1981:197–239; Semenov 1985:126–134; Perlès 2001:232–236). At Makriyalos, however, contrasting patterns of raw material selection suggest that these three morphological types are not just archaeological categories, but were perceived as different by their producers. However, the rocks chosen (coarser-grained igneous rocks for axes; fine-grained igneous rocks for adzes and serpentinite for chisels), do not entirely match functional expectations. In the case of axes, rocks resistant to impact force would be expected, but coarser-grained rocks were favoured which, due to the larger crystals set in their matrix, are likely to withstand impact force less well than the finer-grained alternatives (Dickson 1981). Yet the latter cate-



gory and in particular basalt, which represent the toughest rocks in the Makriyalos assemblage, are preferentially used for adzes, supposedly employed in lighter tasks. This implies that the choice of raw materials was not shaped entirely by functional considerations (Tsoraki 2008, in press).

The outline of particular traditions of stone selection is also evidenced by the fact that some suitable materials for the making of edge tools were largely ignored or avoided altogether. These included sandstone with tightly cemented grains and marble, both of which were employed very frequently in other stone-related activities. As argued elsewhere (Tsoraki 2008, in press), the textural characteristics of these rocks do not preclude their transformation into edge tools. Yet the Makriyalos community deployed them only rarely in this way. Similarly, the scarcity of flint axes, a wider phenomenon of the Greek Neolithic (Perlès 2001:232–233) may be not only a question of availability and utility, but also a function of strong cultural traditions in the selection of particular raw materials for specific tool categories. That such traditions existed is demonstrated in the production of other stone categories. For example, marble was used exclusively for making mortars/vessels despite the fact that serpentinite, a rock consistently used for vessel manufacture during the Aegean Bronze Age (Bevan 2007: 58), was widely available. Similarly, pestles are preferentially made of igneous rocks while stone amulets are exclusively made from marble and stone beads from serpentinite. Moreover, stratigraphic evidence suggests that

these specific traditions of choice were maintained across both phases on the site.

At Makriyalos then, as elsewhere, the preferential use of certain rocks for particular object categories cannot be interpreted solely on practical grounds such as local availability of geological resources, textural characteristics, functional suitability of rocks and/or ease of working (Tsoraki 2008, in press). Instead, the exercise of choice was governed by cultural understandings that determined which materials were *appropriate* for the creation of specific object categories. Similar ideas of *appropriateness* seem to have been expressed in other activities of the Makriyalos community such as bone tool manufacture (Isaakidou 2003), as well as in stone-related activities of other Aegean prehistoric communities (Perlès 2001:3, 242; Carter 2008).

Transforming raw materials into tools

Different traditions of working stone coexisted in Makriyalos, characterised by distinct and varied technological choices (e.g. degree of modification and standardisation of products, preferential employment of techniques for different object categories). Generally speaking, stone-working traditions may be divided between objects of an expedient character, that show little or no manufacturing traces (*outils a posteriori*) (cf. Wright 1992:57) such as upper grinding tools, and products of a formalised production sequence (Tsoraki 2008). Edge tool

Table 2.
Spearman's rho
Correlations for the
dimension of adzes
(only specimens with
complete dimensions
are included).

			Max. Length	Max. Width	Max. Thickness	L/W Ratio	W/Th Ratio	L/Th Ratio
Spearman's rho	Max. Length	Correlation Coefficient	1.000	.757(**)	.825(**)	.364(**)	-.353(**)	-.006
		Sig. (2-tailed)	.	.000	.000	.000	.000	.924
		N	232	232	232	232	232	232
	Max. Width	Correlation Coefficient	.757(**)	1.000	.823(**)	-.268(**)	-.014	-.337(**)
		Sig. (2-tailed)	.000	.	.000	.000	.828	.000
		N	232	232	232	232	232	232
	Max. Thickness	Correlation Coefficient	.825(**)	.823(**)	1.000	.052	-.528(**)	-.524(**)
		Sig. (2-tailed)	.000	.000	.	.432	.000	.000
		N	232	232	232	232	232	232
	L/W Ratio	Correlation Coefficient	.364(**)	-.268(**)	.052	1.000	-.567(**)	.451(**)
		Sig. (2-tailed)	.000	.000	.432	.	.000	.000
		N	232	232	232	232	232	232
	W/Th Ratio	Correlation Coefficient	-.353(**)	-.014	-.528(**)	-.567(**)	1.000	.412(**)
		Sig. (2-tailed)	.000	.828	.000	.000	.	.000
		N	232	232	232	232	232	232
	L/Th Ratio	Correlation Coefficient	-.006	-.337(**)	-.524(**)	.451(**)	.412(**)	1.000
		Sig. (2-tailed)	.924	.000	.000	.000	.000	.000
		N	232	232	232	232	232	232

** Correlation is significant at the 0.01 level (2-tailed).



production exhibits a high degree of standardisation in the techniques employed, regularity in the order of different stages and in final tool morphology. Detailed understanding of edge tool production is offered by un-worked material, debitage, semi-finished objects and final products.

The Makriyalos axes and adzes are often trapezoidal in plan, while chisels tend to be rectangular/sub-rectangular. There is also a clear distinction in transverse section between axes (ovate/spherical), adzes (plano-convex) and chisels (flat) (*contra* Moundrea-Agrafioti 1996). These correlations are encountered in both phases of habitation, indicating that the morphology of edge tools did not undergo any changes during the LN period. Given a strong correlation between length and thickness (*Table 2*), the plano-convex shape of adzes would appear to represent a manufacturing choice rather than the result of the modification of the tool. The latter, which would have involved the sawing of the tool perpendicular to its long axis, would have resulted in a weaker correlation between length and thickness. In line with the aforementioned differential selection of raw materials for axes, adzes and chisels, this supports the suggestion that their typological classification is not purely an archaeological construct. Furthermore, this difference in transverse section between axes, adzes and chisels suggests that chisels cannot have simply been reworked axes or adzes that were sawn in half, unless they had also been extensively modified by pecking, grinding and polishing (*contra* Moundrea-Agrafioti 1996).

Various techniques were employed for the transformation of raw materials in edge tools and their subsequent modification: flaking, pecking (*Fig. 3*), grinding, polishing (*Fig. 4*), drilling (*Table 3*) and sawing (for shaping un-worked nodules and for subsequent modification of tools). The flaking technique, similar to other Aegean Neolithic edge tool assemblages (*cf.* Evans 1964:229; Stroulia 2003:9), was employed rather infrequently in the Makriyalos assemblage. The limited use of flaking in the Aegean Neolithic has been linked to the properties of raw materials used for edge tools (Moundrea-Agrafioti 1996; Perlès 2001:233; Stroulia 2003). Nevertheless, flaking has been applied to similar raw materials (*e.g.* dolerite, basalt, andesite, gneiss) in other European assemblages (*e.g.* Cooney & Mandal 1998) so its application may not simply be a function of raw material properties. It may also be linked to particular traditions of working stone in different cultural contexts.



Fig. 3.
Edge tool with
pecked body and
polished cutting edge.



Fig. 4.
Polished edge tool
(missing cutting edge)
(scale in cm).



Table 3.
Frequency of
manufacturing
techniques for bit,
body, margins and
butt of edge tools
(excluding indeterminate
cases and reused tools).

Bit	No.	Percent
Pecked	1	.1
Ground	31	3.7
Flaked	1	.1
Polished	803	95.4
Ground & Polished	3	.4
Pecked & Polished	3	.4
Total	842	100.0

Body	No.	Percent
Pecked	5	.3
Ground	56	3.3
Flaked	1	.1
Polished	1467	87.3
Ground & Polished	16	1.0
Pecked & Polished	127	7.6
Pecked & Ground	7	.4
Drilled	2	.1
Total	1681	100.0

Margins	No.	Percent
None/Natural	1	.1
Pecked	23	1.4
Ground	57	3.5
Polished	1414	86.5
Ground & Polished	9	.6
Pecked & Polished	129	7.9
Pecked & Ground	2	.1
Total	1635	100.0

Butt	No.	Percent
None/Natural	3	.4
Pecked	96	13.0
Ground	89	12.0
Polished	530	71.6
Ground & Polished	1	.1
Pecked & Polished	11	1.5
Pecked & Ground	9	1.2
Drilled	1	.1
Total	740	100.0

Following the initial modification of nodules, mainly by pecking, the final shaping of all parts of edge tools was achieved by polishing (Table 3). Polishing was applied to all edge tools irrespective of their size or raw material, though it was preferred for shaping metamorphic and igneous rocks. Variations between rock categories in the degree of polishing seem unrelated to properties such as hardness. The assemblage contains hard materials that were extensively worked in this way; fine-grained andesite/basalt, gabbro, granodiorite, gneiss, granulite, and serpentinite, while softer rocks, such as marble, were not (Tsoraki 2008). This suggests that the extent to which artefacts were polished could be related to other properties. As argued elsewhere, grinding and polishing accentuate the colour of rocks and give a distinctive appearance to tools (e.g. Edmonds 1995:51; Cooney 2002:95; for an ethnographic example see Toth *et al.* 1992; for the importance of colour symbolism in other archaeological contexts see Jones & MacGregor 2002; Scarre 2004; Bradley & Phillips 2008). The diverse colour scheme of serpentinite, which exhibits varied greenish hues, creates a visually striking raw material (Fig. 5), as is the case with the gneiss (Fig. 6) and pink granite adzes. In this context, the texture of rocks also acquires a new significance. Textural features, such as the feldspars present in gabbro, or porphyritic andesite, as well as the red veins in basalt specimens, can create striking visual contrasts between elements and their matrix. Some of these textures would have also been so distinc-

Fig. 5.
Serpentinite adze
(scale in cm).





Fig. 6.
Gneiss adze
(scale in cm).

tive that they would have readily signalled the origins of the stone to those familiar with the wider landscape. Importantly, it would have been these elements that were highlighted the more time and effort was spent on grinding and polishing.

Considerable effort was also expended in repairing tools, indicated by the time-consuming sawing and multiple episodes of resharpening. Sawing is a complex technique (Moundrea-Agrafioti 1981:184) that requires great understanding of raw material properties and effort. The sequence of steps followed in the Makriyalos assemblage suggests that precision and control were particularly valued during this process (cf. Kelterborn 1991:129). Initially a shallow, narrow groove was created with a tool with a very thin edge, probably a flint blade, usually along the long axis to define where the edge tool would be cut. The tool was then sawn by grinding with stone slabs, with or without the aid of other abrasives (e.g. quartz sand) (cf. Beek with Maika Mason 2002), either from one side only until the opposed surface



Fig. 7.
Edge tool with evidence
for sawing on body.
Sawing used to split tool
in half (scale in cm).

was reached or frequently opposing grooves were sawn until they met and then the tool was snapped in two. During the final stage, traces of sawing (e.g. lips of sawn grooves) were erased by regrinding/repolishing the surface, indicating the importance attached to visual appearance (Tsoraki 2008).

Sawing was used at Makriyalos to split tools in half (Fig. 7), to correct the overall dimensions of tools (sawn margins) and to repair faults (Fig. 8). The use of sawing for the modification of both hard and soft rock types clearly indicates that the difficulty of application to different raw materials did not preclude its use (Tsoraki 2008). As a technique, sawing saves a significant amount of material (Kelteborn 1991) and its employment has been linked to raw material economy and the exotic character of the raw material used (Leshtakov *et al.* 2007). Interestingly, at Makriyalos both locally available rocks and those coming from further afield have been modified through sawing. This suggests that procurement distance alone did not determine whether specific materials were subject to this time-consuming process, nor indeed the value of finished artefacts.

Contrary to many Northern European examples (cf. Bradley & Edmonds 1993), the evidence from Makriyalos indicates that all stages of edge tool production took place within the settlement. Excavation demonstrated the presence of un-worked material, cores, debitage from initial manufacture and from the later



Fig. 8.

Edge tool with evidence for sawing on body on both faces in order to repair fault (breakage indicated by arrow) at the cutting edge (scale in cm).



modification and repair of tools, semi-finished tools and finished objects. Various rocks from equally varied sources (representing local and regional landscapes) were brought to the settlement to be worked and transformed. There is, as yet, no evidence for specialised workshops; the routine working of stone and its transformation into tools took place in different parts of Makriyalos possibly by different actors, and was embedded within a network of activities that had their locus within the large settlement (Tsoraki 2008). This in itself should encourage us to think that even tasks such as raw material procurement were not necessarily carried out in isolation, but were perhaps conducted amongst a range of other gathering or stock-related tasks.

Contrary to previous suggestions (Perlès 1992), the production of edge tools involved the use of time-consuming and arduous techniques regardless of the raw material used. Evidently, the Makriyalos community was interested in devoting time and effort to manufacture. Moreover, the steps followed during production and maintenance indicate a concern with visual appearance and with the creation of smooth and often lustrous surfaces on all parts of an edge tool that again does not correspond to Perlès' argument for a largely utilitarian, efficiency-driven model of production (ibid:134). Most of these tools had an evident utility. Yet the effort expended to define their forms, prolong their lives, and to enhance their appear-

ance, indicates that these tools mattered, that they were valued in various ways by those occupying Makriyalos. This value did not rest solely or necessarily on the distance material had travelled. Nor, so far as we can tell, was work in the hands of a highly restricted and specialised section of the community, strictly separated in spatial or material terms, from other tasks and other people. Instead, the making and using of these often distinctive items was caught up in the fabric of routine life as it was followed by the Makriyalos community.

Consumption patterns: does size matter?

Beyond morphology, questions of edge tool function have often been answered via metrics. In other words, it has often been argued that the function of edge tools depends on their size and in particular their length (e.g. Moundrea-Agrafioti 1981; Sugaya 1992; Cooney & Mandal 1998:39; Alisoy 2002; Stroulia 2003). This has not proved a particularly sensitive measure, though it has been the basis for identifying tools that are either so small or so large that they are likely to have been of limited utility. It is these exceptions that have usually been labelled as symbolic (cf. Skeates 1995; 2002:14–15).

At Makriyalos, the 337 complete edge tools have an average length of 4.9cm ($\sigma = 1.88$)



ranging from 1.8cm to 14.4cm and only 1% of tools are longer than 10cm. The average width is 3.5cm ($\sigma = 1.12$) and the average thickness 2.1cm ($\sigma = 0.88$). Overall these figures are comparable with those given for the dimensions of edge tools in other Aegean Neolithic sites (e.g. Moundrea-Agrafioti 1981:199–201; Evans 1964; Mylonas 1929:71–72; Stroulia 2003). Notable exceptions are a diabase axe from Anemodouri, Peloponnese, and a serpentine axe from Nea Nikomedia that measure more than 27.5cm, and a few others that measure between 15 and 20 cm (Sugaya 1992:72, fn 3; Mould *et al.* 2000). Overall, Aegean edge tools have a relatively small size, especially when compared with their Northern European counterparts (cf. Edmonds 1995; Wentink 2008) but correspond to those from the central Mediterranean region (Skeates 2002:14) and the Balkans (Leshtakov *et al.* 2007).

With regard to the size and function of axes, Skeates (2002) argues that miniature axes (between 1.5 and 5.5 cm in length), were too small to be used in most activities and thus their practical value is unclear. The majority of the Makriyalos edge tools, however, have been heavily used irrespective of their size, although larger tools seem to have been used in tasks requiring greater impact force. Chisels and small-sized edge tools in general were employed mainly for lighter tasks. In fact, the worn condition of tools as a whole suggests their use on a regular basis (Tsoraki 2008). This point seems to contradict previous suggestions that ‘lustrous polish’ reflects the non-functional/symbolic character of such tools (Strasser & Fassoulas 2003–2004:9–10). At Makriyalos, highly polished tools very frequently exhibit heavily used or worn out use-faces and were by no means non-functional. This perhaps highlights the inherent problems in creating an opposition between the practical and symbolic aspects of tools (Edmonds 1995, 2004). Indeed, even the very large axes found in Nea Nikomedeia show signs of use (Sugaya 1992: 72).

It can be argued then, that size was not the sole factor determining the utility of tools. Even though most Makriyalos edge tools are rather small, they often saw more than one episode of resharpening and modification (cf. Tsoraki 2007:Fig. 3). And as the wear on most cutting edges illustrates, a small size did not necessarily make edge tools any less functional, though it could result in their being used in different kinds of activities (*contra* Skeates 2002:15).

An important issue that remains is why people at Makriyalos chose to use tools of such a

small size and invest time in their modification and reworking. The different episodes of resharpening, sawing to alter or restore the overall proportions of tools, and careful finishing of the surface, all indicate that users/owners were willing to invest time and effort in the maintenance of tools they used on a regular, perhaps daily, basis. Their routing use, therefore, may have facilitated a strong sense of individual ownership (Toth *et al.* 1992; Pétrequin & Pétrequin 1993; Edmonds 1995:103; 2004). In that sense, the tendency to deposit edge tools within the habitation area more frequently than communal areas during Makriyalos I perhaps hints that people chose to curate in the domestic arena objects which were regarded as personal belongings, often of distinctive appearance (Tsoraki 2007, 2008).

The possible link between particular people and individual edge tools is strengthened by examples within the Makriyalos assemblage in which perforations were drilled to perhaps allow the tool to be worn as an ornament. One of these examples is a broken tool that may have been regarded as appropriate for use as a pendant when it could no longer function directly. The biographic associations of tools, therefore, may have encouraged curation, maintenance, a form of attention that kept stories in mind just as it kept tools in the hand.

Falling out of use

Edge tools were varied and valued components in the routine technologies of the Makriyalos community. Most were used, repaired and refashioned before they were finally exhausted, broken and discarded. Some were not.

Analysis suggests that edge tools were exposed to fire more frequently than other artefacts (Tsoraki 2008), a high frequency that makes burning by accident unlikely. Some of these tools may have been deliberately destroyed by burning, an act that is evidenced in Neolithic assemblages elsewhere in Europe (Larsson 2000; Edmonds 2004). Burning might have been deliberately used as a means to take edge tools out of use, perhaps because broken tools could have been (and often were) reworked into smaller tools and therefore would not have been removed irreversibly from circulation. Burnt edge tools, on the other hand, could not have been used for their original purpose. Chapman (2000:93–94) has suggested that the completeness of edge tools carried symbolic connotations (see for instance axe hoards). In those terms, burning was a means



of symbolically 'killing' axes and adzes, removing them from use without breaking or altering their original form.

A further indication that the shape of edge tools had symbolic connotations is the reproduction of the form of axes and adzes in materials other than stone, for instance clay axes and adzes at Neolithic Achilleion and Nea Nikomedeia (Winn & Shimabuku 1989; Sugaya 1992: 74, fig. 14; for other examples of axe/adze replicas see also Lillios 1997:157–158). Moreover, both archaeological and ethnographic studies suggest that the form of the axe/adze is a common representational motif which in many cases appears to have acted as a powerful symbol (Thomas & Tilley 1993; Edmonds 1995; 2004:43). One possible interpretation of the deliberate destruction of edge tools is that such tools were linked to the life-cycles of their users and were destroyed, for example, at their death (Brück 2006:297). Once again, the point here is that these kinds of treatment most likely happened as a function of the biographic and other associations held by individual tools.

Traditions of working stone: creating networks of people and places

Working stone into edge tools involved the appropriation of different geological resources and the recurrent combination of different techniques. Indisputably, the physical and mechanical properties of stones posed constraints and created potentials allowing them to be worked in different manners. Overall, the character of different *chaînes opératoires* demonstrates that working stone at Makriyalos was a practice that was firmly founded on knowledge of the properties of stones, on shared ideas of appropriateness that determined which rocks should be used and how tools should be made. Thus, edge tools were the outcome of a valued technological practice encapsulating an array of meanings for the Makriyalos community.

The symbolic potency of rocks and the mineral world is a subject that has captured the interest of archaeologists and ethnographers alike (see for instance Boivin & Owoc 2004). Rocks and minerals in many pre-industrial cultures around the world are regarded as particularly powerful substances and the perception of their qualities and their appropriate use is influenced by a wide range of cultural ideas about gendered associations, age and cosmology. Similarly, the sources of these materials are often thought to be very powerful places in the

landscape and the understandings of these landscape locales therefore play a prominent role in the way the rocks that come from them were perceived by contemporary users (Taçon 1991). Despite these suggestions discussion in the context of Aegean prehistory rarely goes beyond functional characteristics and availability (Carter 2008). The selection of rocks for the production of different object categories, however, is a process inextricably bound to the different ways in which societies conceive elements of the physical world and hence each society may have its own principles of categorization (e.g. Taçon 1991).

Raw material variability indicates that the Makriyalos community held a detailed knowledge of their local and wider landscape. This included primary outcrops, where they were exploited. But it also included secondary deposits. As Scarre (2004) has noted elsewhere, the use of mainly surface deposits (e.g. river beds) for edge tool manufacture was itself important as it allowed for the creation of associations between particular features of the landscape (rivers) and raw materials. Particular choices in the *chaînes opératoires* of edge tools would have brought these associations into focus. Polishing emphasised the colour and texture of stone, making links between rocks, tool forms and the wider landscape. To those with knowledge of the craft, the objects produced acted as references to places in local and regional landscapes. By transporting rocks from different sources back to the settlement, Makriyalos became a focal point where elements of different places of the landscape were brought together; and through the working of stone the associations between people and places were reworked and provided with a new significance.

Conclusions

In contrast to the situation in more northern parts of Europe, stone axe studies in the Aegean are still at a relatively early stage. Knowledge of possible sources and raw material usage is limited and this restricts our understanding of patterns of production, exchange and other forms of consumption. However, recent work on procurement patterns has revealed a far more complicated situation than was previously thought (cf. Melfos *et al.* 2001; Dixon 2003; Stroulia 2003; Strasser & Fassoulas 2003–2004; Strasser 2005). The analysis of the Makriyalos assemblage indicates that the procurement of raw materials for edge tools relied on both local



and non-local sources which were acquired either through direct procurement or through some form of exchange mechanism. An important next step in research will be to explore the nature of those mechanisms.

What I have also shown is that the procurement of local or non-local stone does not need to be interpreted solely in terms of mechanical properties or utility (e.g. Stroulia 2003:8). These issues are certainly important. But they need to be set alongside other concerns; links with places and with people, which would have also held a significance at the time, and may have played their part in determining how tools were made, used, curated and discarded/deposited.

A critical assessment of the *chaîne opératoire* of the Makriyalos edge tools clearly reveals that these were far from mundane artefacts. They were the result of complex patterns of choices, informed by cultural understandings of *appropriateness*. Certain raw materials were regarded as fitting for the production of edge tools while others were not. The Makriyalos edge tools were products of a distinct technological tradition, and their biography suggests that they saw intensive practical use but were also imbued with symbolism manifested throughout the sequence of production, consumption and final deposition. Overall, the exploration of the entanglement between people, landscape and materials allows us to understand how these tools were caught up in the broader webs of social relations and shows the manner in which stone-working materialised cultural attitudes and valuations.

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■ ■ ■ Even in the nineteenth century, the origins of a blade could reflect upon its owner. Thomas Boynton amassed thousands of pieces from across Yorkshire, and like many of his contemporaries, coveted antiquities from the continent. These he displayed in purpose-built cabinets, with the finest pieces held for presentation in individual velvet lined cases (commissioned from *Bryce Wright*, a specialist firm in Great Russell Street, just along from the British Museum).

Prominent in his collection were a number of diminutive stone blades, each with its original antler sleeve, which he obtained during visits to the waterlogged *Neolithic Lake Villages* being found in the shadow of the Alps. Acquisition of these pieces caused quite a stir. Here were artefacts from sites that featured prominently in the discourses of the day, in arguments that harnessed stone and metal to crude socio-evolutionary schemes. But it was more than just the remarkable survival of organic remains that made these sites so important. For scholars at the time, the complexity and sophistication of the material reflected a 'great leap forward', a break from savage beginnings and a significant step on the path towards civilisation and the (western) present. Axes from such sites were thus potent *symbolic capital*, a source of renown that Boynton sought when he laid on an exclusive display for the members of the Yorkshire Philosophical Society. ■



●●● *The boxes turned up alright, stuffed with neat rows of small brown paper bags containing worked flint. But the axes were missing, as were all the arrow-heads and a blade core. Turns out these were the best finds. They'd been pulled out of the archive years before; mounted in temporary displays and passed through so many hands that no one now has a clue where they are. ●*



The Mynydd Rhiw quarry site:

Recent work and its implications

Abstract

Mynydd Rhiw, the source of Group XXI axes, has been well-known since the 1950s and has made a minor contribution to stone axes studies since this time, in line with the apparently modest scale of quarrying undertaken at the site. This paper documents recent fieldwork which shows that quarrying at Mynydd Rhiw was much more extensive than previously recognised, and has provided new insights on the character and chronology of working in the immediate area. Following an introduction to the site and its archaeology, this paper addresses two specific areas: the difficulties involved in establishing a chronology for quarrying at the site; and the implications of an apparent mismatch between the large scale of quarrying and the apparently small contribution that Mynydd Rhiw appears to have made to broader networks of axe distributions.

Introduction

Mynydd Rhiw, the source of Group XXI axes has been well-known since the 1950s and has made a minor contribution to stone axes studies since this time, in line with the apparently modest scale of quarrying undertaken at the site. Recent work has shown that quarrying at Mynydd Rhiw was much more extensive than previously recognised leading to a need to re-evaluate the site's position in the story of Neolithic axe production and distribution.

Following an introduction to the site and its archaeology, this paper addresses two specific areas: the difficulties involved in establishing a chronology for quarrying at the site; and the implications of an apparent mismatch between the large scale of quarrying and the apparently small contribution that products from Mynydd Rhiw made to networks of axe distributions.

Topography and geology

Mynydd Rhiw is an elongated hill, 304m high, at the western end of the Llyn peninsula in northwest Wales (Ordnance Survey grid reference SH 2285 2938). Its summit offers commanding views: on a clear day, north to Anglesey, east to Snowdonia, west to Ireland and south as far as Pembrokeshire. Bronze Age

cairns occupy high points along the east side of the hill and at least one other was built on a similar position on the west side (RCAHMW 1964), see *Fig. 1*.

The majority of the hill is composed of dolerite from the Gallt y Mor and Maen Gwenonwy sills, this has been traced, by magnetometer survey, from the coast to the ground north-eastwards from Porth Ysgo to Mynydd Rhiw (Brown & Evans 1989). This dolerite was intruded into wet sediments which on Mynydd Rhiw are represented by the Trygarn Formation. The sediments comprise an altered tuffitic siltstone and, to the west, a band of Mynydd Rhiw Rhyolitic Tuff (both are referred to in this paper as tufaceous sediments). Due to the nature of the intrusion, the dolerite and sediments outcrop in alternating bands following the strike of the hillside.

This tufaceous sediment is fine-grained and can be readily flaked, making it well-suited to the production of stone tools. Flakes, possibly of Mynydd Rhiw material, have been recovered from a Mesolithic assemblage found on Bardsey Island, 13km to the southwest (Edmonds *et al.* 2004), hinting at an early appreciation of the hill's potential. But the tufaceous material only seems to have been exploited on a large scale during the Neolithic.

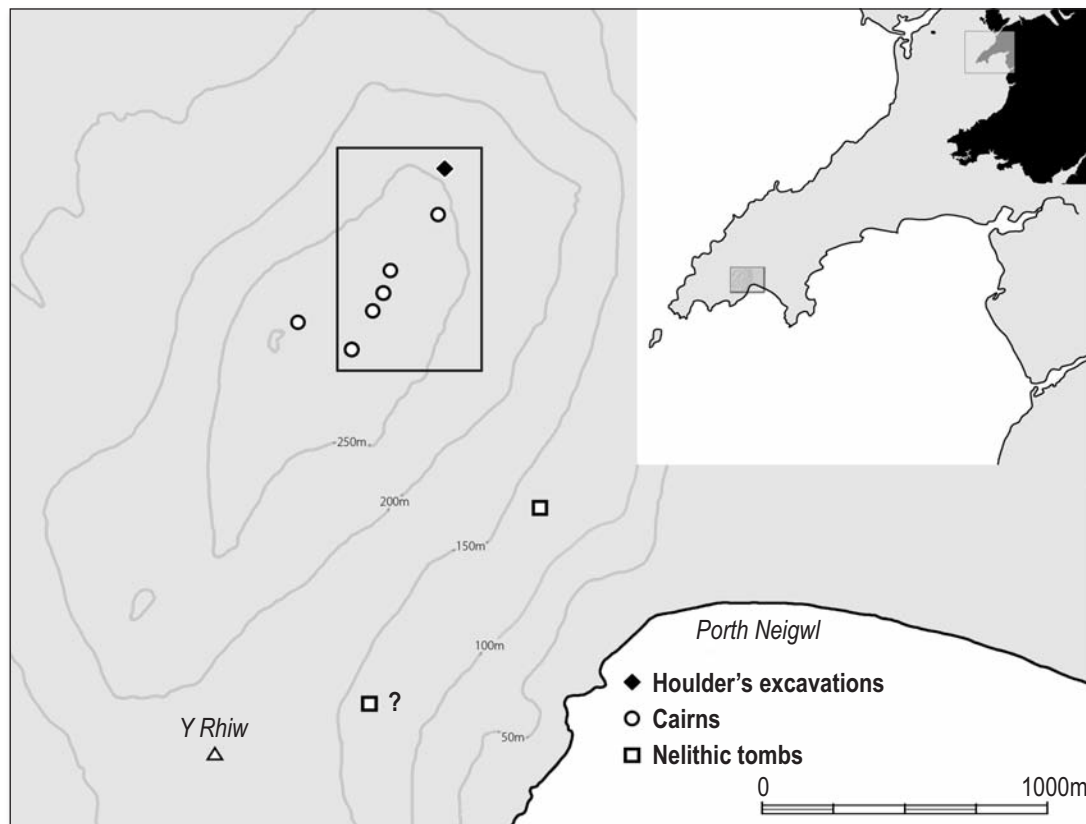


Fig. 1.

Location of study area. See *Fig. 3* for detail of area discussed in the text.

This map is based upon data produced by the Ordnance Survey (reproduced with the permission of Ordnance Survey on behalf of The Controller of Her Majesty's Stationery Office, © Crown copyright 2010).

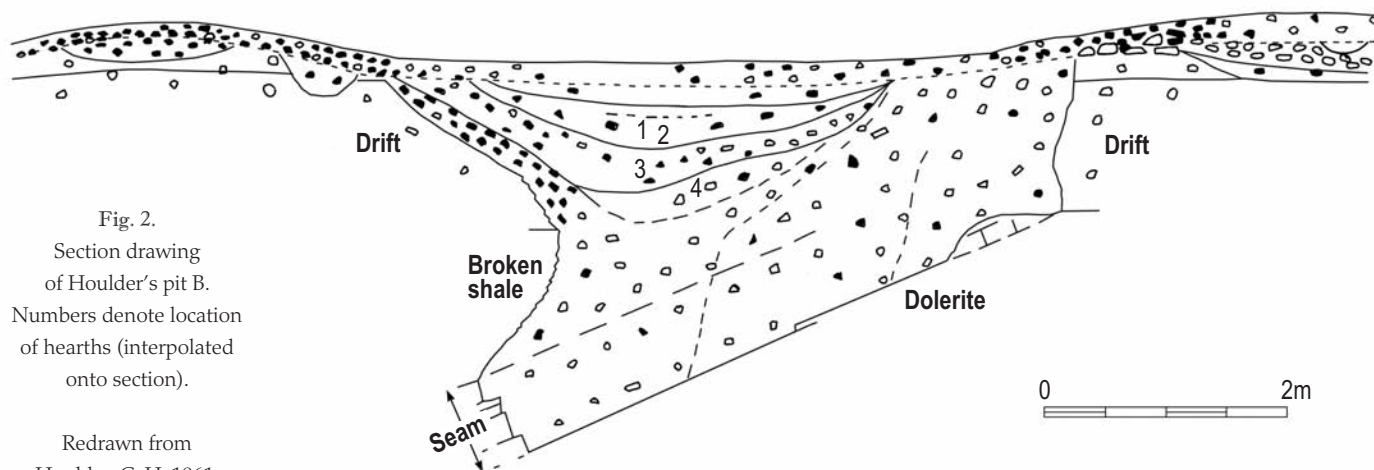


Fig. 2.
Section drawing
of Houlder's pit B.
Numbers denote location
of hearths (interpolated
onto section).

Redrawn from
Houlder, C. H. 1961.
The excavation of a
Neolithic stone
implement factory
on Mynydd Rhiw
in Caernarvonshire.
*Proceedings of the
Prehistoric Society* 27,
Fig. 5.

Previous work

Worked stone has been found on Mynydd Rhiw since the 1930s (Grimes 1951:no. 245), but the archaeological potential of the mountain was first brought to general attention through surveys undertaken by the RCAHMW in preparation for their *Caernarvonshire* volume (RCAHMW 1964). During this time, A H A Hogg noticed flaked stone in the make-up of what he took to be a number of hut circles on a level, and apparently featureless, part of the hillside. This attracted the attention of Chris Houlder who carried out two seasons of work in which he demonstrated that the hut circles were in fact upcast from five quarry pits arranged in a line along one of the tufaceous seams. This 0.7m wide seam was encountered below about 1.4m of drift deposit, and was of variable quality across its width. Furthermore, it fell away at a 25° angle making it difficult to extract rock in any quantity without the need to remove large amounts of waste. The effort involved increased with depth, and the deepest pit which Houlder excavated was found to be 3.3m deep (Houlder 1958, 1959, 1960, 1961), see Fig. 2.

New discoveries

Houlder's work provided an important snapshot of how quarrying was undertaken at Mynydd Rhiw in the Neolithic. A single pit was dug, rock was extracted and flaked, and when it became too difficult to extract more rock a new pit was begun along the projected line of the tufaceous seam (Houlder 1961). One outstanding question regarding this quarrying methodology was how Neolithic people had known that the seam was present in the first place – the quarried area is flat and the nearest

outcrops of rock are almost 40m away. Houlder's explanation was that people had come to the area, recognised there were some fine-grained pieces on the surface and had followed them down until the seam was reached (Houlder 1961:110), however, this model did not seem to the author to be very likely.

This led to the current project which began in 2005 with a survey of the hill in the hope of locating outcrops of tufaceous material which might have provided a more obvious spur to the Neolithic quarrying. This revealed very few surface traces on the north and west sides of the hill, where Houlder had worked, but very good outcrop exposures to the south and east. Here the tufaceous outcrops weathered white, making them readily identifiable. A subsequent topographic survey in these areas revealed a number of quarry scoops cut into the slope of the hill where the ground levelled out to form a terrace running roughly northeast / southwest. Further quarry scoops, and spoil heaps were found on the terrace itself, as well as one intact, Houlder-style pit consisting of a circle of upcast containing flaked material, surrounding a central depression (see Fig. 3). In total, evidence of quarrying extended on and adjacent to the terrace for about 600m, in a strip up to 60m wide. Both quarrying and terrace followed the course of a band of tufaceous sediment.

At the south end of this zone of quarrying, where the hill drops towards Rhiw village, substantial quarries were identified cutting into this band, and it is likely that these were worked in the 19th century when the fine-grained rock was used to make ornamental surrounds for windows and garden walls. Upslope the quarry scoops were smaller and more weathered in outline.

Early in 2006, wildfire cleared the vegetation from the south side of the hill revealing a large number of worked flakes scattered on the sur-

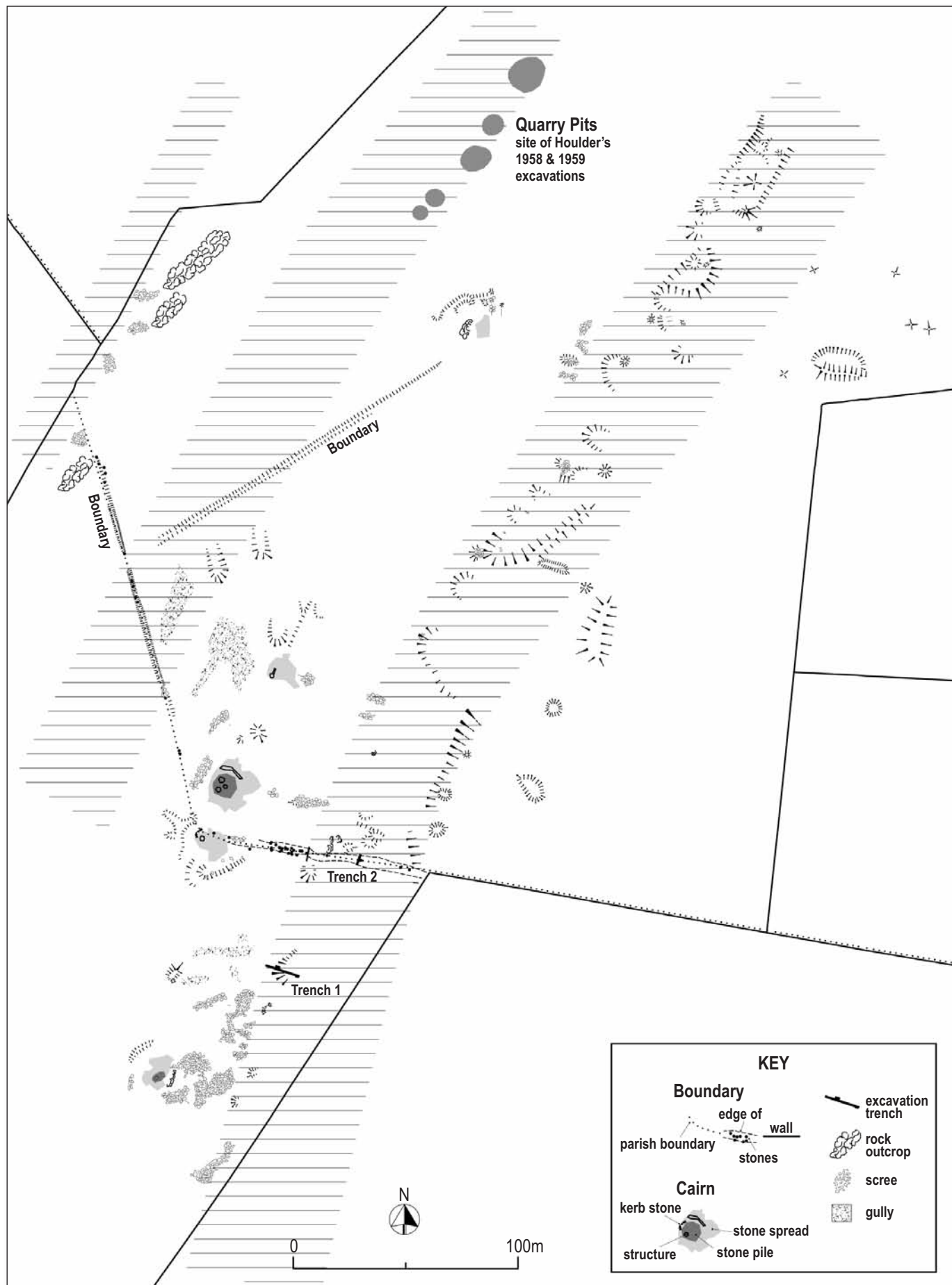


Fig. 3.

Survey of the east side of Mynydd Rhiw, produced by the Royal Commission on the Ancient and Historical Monuments of Wales, with the assistance of staff from English Heritage. Hashed areas indicate seams of tuffaceous sediment.

Crown copyright Royal Commission on the Ancient and Historical Monuments of Wales, 2010. Geological data is reproduced with the permission of the British Geological Survey ©NERC. All rights Reserved.

face along the terrace. These were similar in form to the material recovered by Houlder during his excavations, hinting that the weathered quarries may have been Neolithic. Consequently, in September 2006 an 18m long trench was excavated across one of the quarry scoops (Trench 1). Its surface morphology suggested that this might be the remains of a single quarry, up to 10m across, dug into the hillslope at the junction of dolerite and tuffaceous sediment. But excavation quickly demonstrated that the scoop had in fact been formed by numerous smaller quarrying events.

Trial excavations

Trench 1 stretched from the clear ground upslope and to the west of the scoop, down across the irregular depression left by quarrying, and extending out onto the level terrace to the east (see Fig. 4). It was dug down to natural along its length, revealing undisturbed subsoil at both ends, but with a 1.7m long exposure of in situ tuffaceous bedrock in the centre. Adjacent to this bedrock and extending to the east, the natural subsoil consisted of a regolith of shattered tuffaceous blocks bound in a compact silty matrix. Unsurprisingly, stone made up a large proportion of the trench's fill, with several large boulders providing a particular challenge for

the excavators. The proportion of stone types in the trench changed across its length, reflecting changes in the underlying geology: a high proportion of dolerite at the upper, west end of the trench, a high proportion of tuffaceous sediment to the east. The dolerite showed no signs of having been worked; the tuffaceous material included both worked and unworked pieces.

The approach to stone procurement adopted at Mynydd Rhiw (see later), makes it likely that the subsoil along the entire length of the trench had been turned over to a greater or lesser degree during the lifespan of work in the area. This made it difficult to identify specific quarry events unless they were late in the sequence of working, or unless they had left a clear cut into the subsoil. Three events met these criteria, and these are described in sequence from west to east along the trench.

At the top of the slope, a 0.7m deep pit had been dug through the subsoil, revealing a block of stone. This had then been pulled out, leaving behind an impression where its angular base had once stood. This angularity suggested that the block had been of tuffaceous sediment rather than dolerite, the latter weathering to a rounded rather than an angular form. The distinctive nature of the fill of this cut, and the survival of the stone's impression make it likely that this quarry event was one of the last to have occurred in this area.

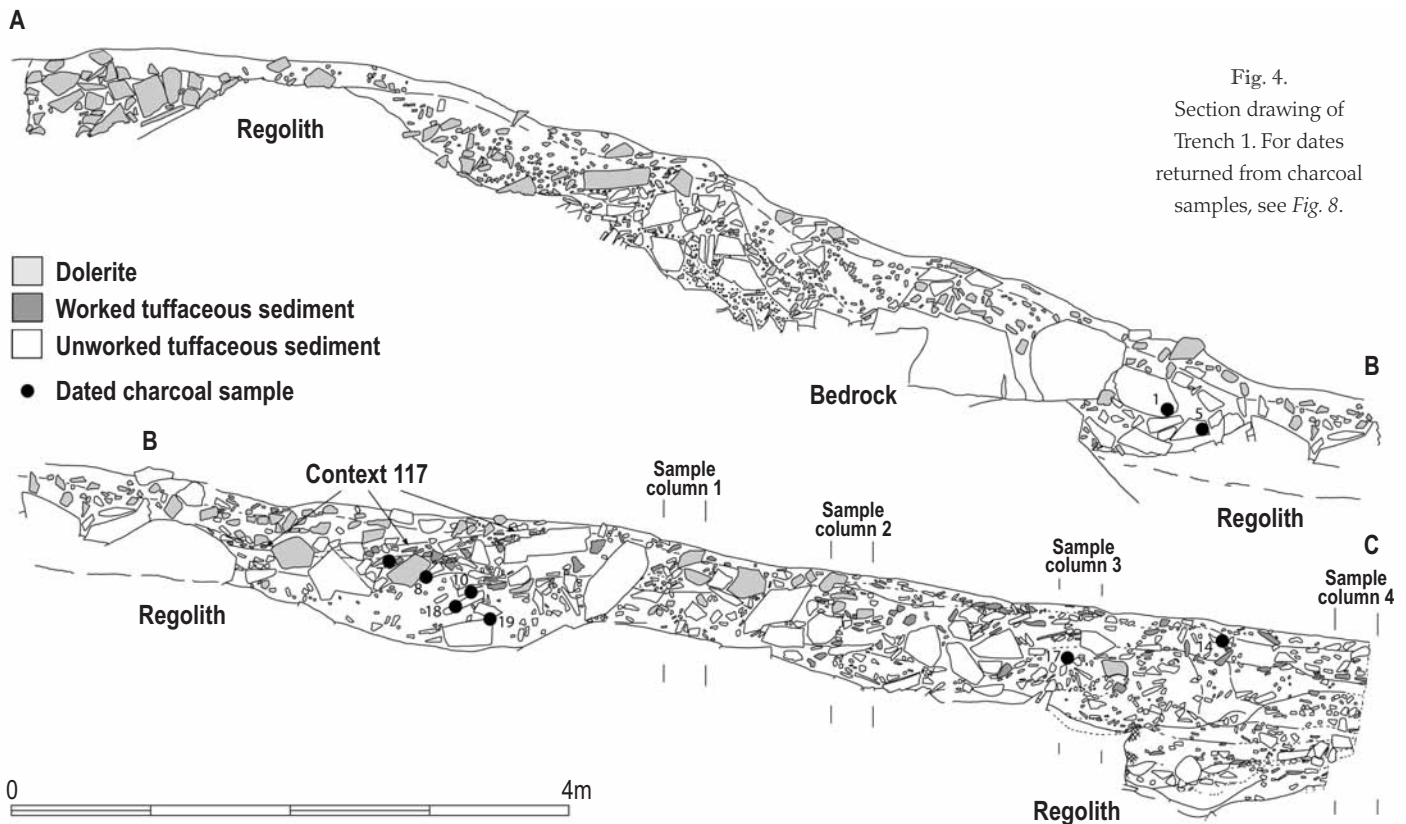


Fig. 4.
Section drawing of Trench 1. For dates returned from charcoal samples, see Fig. 8.

The position of the other two quarry episodes in the relative sequence of events is uncertain since they only survive as cuts in the subsoil, with the possibility that their fills had been reworked several times. The first of these scoops was found around 2.8m east of the exposed bedrock, cutting into the regolith. It only survived as a wide and shallow depression in the natural, 2.6m long and cutting less than 30cm deep. The scoop contained some flaked material, as well as small fragments of charcoal. Above this, was a band of dark silt which rose up to the surface (context 117). This contained flaked material lying flat as though deposited on an original ground surface. This surface and its debris sealed the quarry scoop beneath. Context 117 was the most westerly to contain worked debris, but from this point east flakes and worked blocks were found throughout most contexts, with some containing pockets of microdebitage, indicating that fine working had taken place in the area as well as roughing out.

The final discernible quarry event was at the east end of the trench, where a c. 0.4m deep vertical-edged cut were found in the regolith. The total depth of fill above the flat base of this cut was 1.4m, and within it was flaked debris and occasional charcoal. The other end of this quarry event was not located within the trench and must therefore have lain further east along the terrace.

This cut, and the depth of fill above it was a considerable surprise. In positioning the trench it had been assumed that evidence of quarrying would be restricted to the middle part, where the slope of the hillside had clearly been dug away. It was anticipated that the eastern end, where there were no surface indications of quarrying, and where the ground levelled out onto the terrace, would feature quite shallow deposits. In the event the terrace concealed the deepest quarry fills, raising the possibility that the entire area may preserve similar depths of quarry debris. The likelihood that this is the case is strengthened by the discovery of multiple quarry scoops across the terrace (as noted above), and by the results of trial excavations undertaken in 2007.

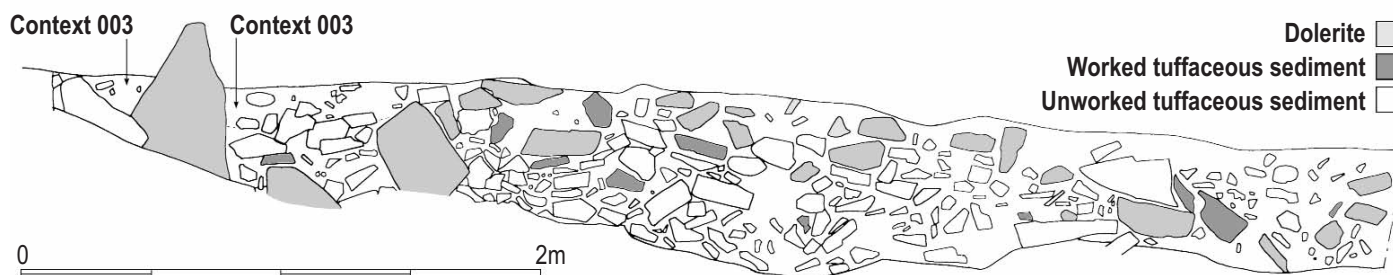
The 2007 trench was smaller, just 1.0 x 5.2m long, and was dug to the north of Trench 1, 60m further along the terrace. It was aligned north-northeast / south-southwest over the surviving course of a rough stone wall which marks the line of the current Aberdaron / Botwnnog community boundary, and which continues upslope to the west to meet one of the Bronze Age cairns. It was hoped that the wall would have preserved an old ground surface above quarried material, but in the event it proved so poorly preserved that it was hard to identify the line of the wall in the trench section at all, other than as a broad spread of dolerite rubble (see Fig. 5).

Immediately below the surface of Trench 2, at its north end was found a 0.15m thick dark soil deposit, extending across the width of the trench for 1.4m. Within this was found an Early Bronze Age button of Whitby jet. This overlay a mass of poorly consolidated and sometimes soil-free flake debris which extended over the entirety of the trench to a depth of more than 0.7m, at which point excavation was stopped due to resource limitations. The frequent voids within the mass of flaked waste, gave the impression that the area had not been disturbed since the quarry event which produced them.

The considerable depth of quarry debris found in both Trench 1 and 2 and the surface traces (quarry scoops, spoil heaps and loose flake debris) indicate quarrying at multiple locations along the length and across the width of the terrace. At present therefore it seems reasonable to speculate that the entire terrace may have been quarried to a depth of more than 0.7m.

Detailed study of the blocks and flake debris from the trenches is still ongoing, preventing definitive statements regarding the purpose of the quarrying, but provisional comment can be made. Many flaked blocks were recovered, suggesting initial testing of material which was subsequently abandoned. Flakes ranged in size from very substantial pieces indicating primary block working, through to secondary and tertiary flakes, as well as microdebitage, indicating fine working on site. Several hammerstones were found in both trenches – some which were

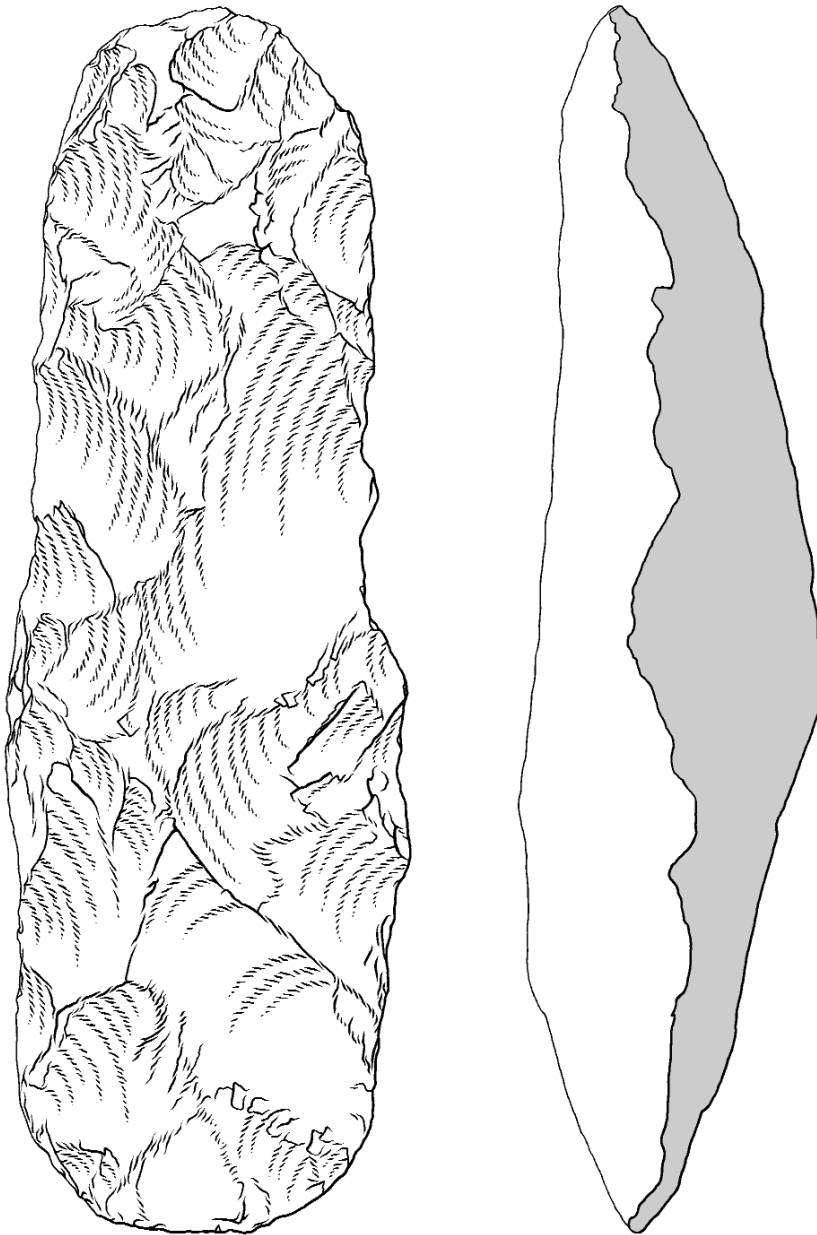
Fig. 5.
Section drawing
of Trench 2.



large enough to have needed both hands to lift were clearly suited to the initial breaking up of blocks, or possibly bedrock; smaller examples would have been better suited to more detailed knapping. All the certain examples were cobbles presumed to have been brought up from the beach at Porth Neigwl, 1.5km away. It is unclear whether local dolerite was also used for hammerstones as, while this material occurred in suitable sizes and shapes, the surfaces of all the pieces in the trench were badly decayed.

The vast majority of tools produced during quarrying were probably taken from the site to be used elsewhere, but a number of roughouts were recovered. One was a particularly fine example (see Fig. 6), but most were either broken, or poorly formed – possibly providing an explanation for their abandonment. Alter-

Fig. 6.
Roughout recovered
from east end
of Trench 1.



natively, it could be argued that these were not axe-roughouts, but rather they were rapidly-shaped digging tools, made on site as part of the quarrying work and abandoned when digging was complete (Weddle pers comm. and see Milner *et al.* 2010). In Houlder's area, small tools were also found, but this has not been demonstrated with certainty on the east side of the hill, where many of the recovered flakes have edge damage but, as the stone is very brittle, it is often hard to be certain whether this is a result of rough retouching or rough handling.

The properties of the rock are also quite variable, ranging from coarse and robust, to fine and brittle. Experimental work by Dave Weddle has demonstrated that the former is better suited to the production of large items which had to withstand heavy use – adzes, axes and mattock-heads; while the latter is better suited to the manufacture of edged tools designed to be used with more precision – such as scrapers, knives, arrowheads.

Trench stratigraphy

During excavation attention focused on the identification of cuts and layers in order to identify a sequence of quarry events. This proved very difficult; the narrowness of the trenches meant it was impossible to see features in plan, requiring detailed study of the section. In a few areas it was possible to recognise layers where flaked material clustered with a similar alignment (e.g. context 117 in Trench 1) and pockets of microdebitage, but for the most part the relatively homogeneous subsoil made it difficult to discern separate events. Two strategies were therefore adopted in Trench 1, to see if a sequence could be discerned by other means.

The first had been decided upon before work began. Four 30cm long, trench-wide columns were designated in the lower, eastern, half of the trench with all materials from these columns being bagged in 10cm spits. The rock fragments contained in these samples were then separated into worked and unworked tufaceous sediment, and dolerite. Analysis of the weight of these materials in each column and between columns failed to identify patterns which would suggest the survival of coherent layers or working floors in these areas (see Fig. 7). This suggested that deposits in the lower part of the trench, towards the terrace, had been turbated to some degree.

The quarrying strategy most appropriate to acquiring rock on this side of the hill may provide an explanation for some of this turbation.

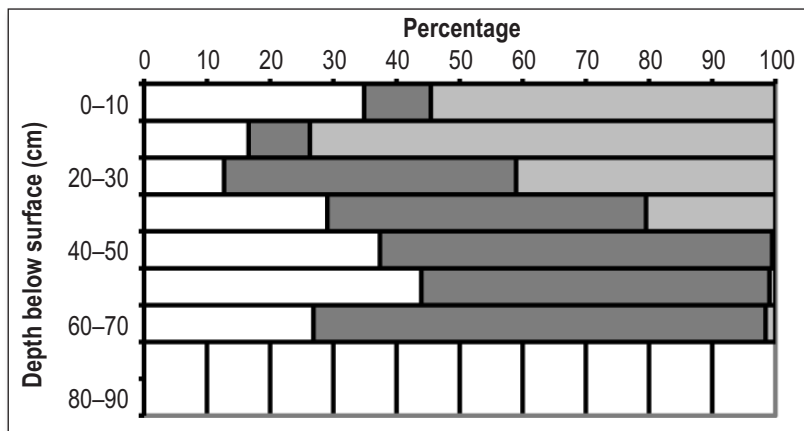
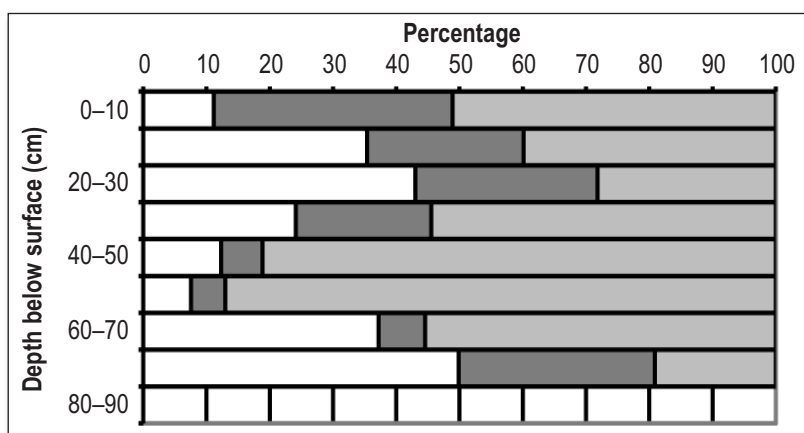


Fig. 7.
Proportion of rock types
(by weight) found in
each of the four sample
columns marked on Fig. 4
(top, column 1;
bottom, column 4).

Key:

light grey, dolerite;
dark grey, worked
tufaceous sediment;
white, unworked
tufaceous sediment.



Whereas in Houlder's area stone was extracted from pits dug into the bedrock, on the east side of the hill the quarry pits did not reach so deep. Here it seems that diggers were trying to find shoebox-sized blocks of tufaceous sediment of a type still common in the overlying drift, thereby removing the need to break blocks from bedrock. The scale of working on this side of the hill makes it likely that the same areas would have been dug over repeatedly as old quarry areas became concealed by later spoil. This would have led to the breaking up of old working horizons and the digging through of previous cut and fill sequences. As will be seen below, this activity was probably not confined to the Neolithic.

Radiocarbon dating

Further exploration of the problem of turbation and reuse of the site took place after the excavation in the form of a dating programme selecting charcoal from different depths along the length of Trench 1. The difficulties stemming from the dating of charcoal from layers rather than sealed contexts are well known, but it was felt important to learn over what period the turbation of the quarry area had taken place.

Nine samples were dated from Trench 1 with two more coming from securely contextualised charcoal retained from Houlder's excavations. Dating, by accelerator mass spectrometry was undertaken on single pieces of charcoal which had been identified to species level.

Throughout this paper all calibrated dates have been produced using the IntCal 04 calibration curve (Reimer *et al.* 2004) and OxCal v4.1.3 (Bronk Ramsey 1995, 1998, 2001, 2009), and are presented at 95% confidence. They are quoted as recommended by Mook (1986), with end points rounded out to 10 years (for error



Fig. 8.
Radiocarbon dates from:
a:
Trench 1 of
Mynydd Rhiw East;
b:
Pit B of Houlder's
excavations.

	Date	$\delta^{13}\text{C}$	Sample	Date range cal BC	Number of Fig. 4
a	UBA-7774 4738±28	-21.0	Charcoal (oak)	3640 – 3370	1
	UBA-7801 4558±43	-23.0	Charcoal (Common hazel)	3500 – 3100	5
	UBA-7776 4567±27	-17.0	Charcoal (oak)	3370 – 3120	7
	UBA-7777 2797±36	-20.0	Charcoal (birch)	1050 – 840	8
	UBA-7778 4658±25	-25.0	Charcoal (oak)	3520 – 3360	10
	UBA-7779 4917±24	-25.0	Charcoal (<i>Prunus spinosa</i> L.)	3760 – 3640	14
	UBA-7780 3833±26	-25.0	Charcoal (<i>Prunus spinosa</i> L.)	2460 – 2200	17
	UBA-7781 4895±32	-31.0	Charcoal (Common hazel)	3720 – 3640	18
	UBA-7782 4843±24	-26.0	Charcoal (Common hazel)	3660 – 3540	19
b					
	UBA-7802 3081±42	-27.0	Charcoal (Common hazel)	1440 – 1220	Hearth 1
	UBA-7803 4589±36	-25.0	Charcoal (Common hazel)	3500 – 3130	Hearth 2
	Superceding the following bulk sample date:				
	Q-387 3094±90		Charcoal (unspecified species)	1530 – 1120	Hearth 2

ranges equal or greater than 25 years). The ranges quoted in Fig. 8 have been calculated using the maximum intercept method (Stuiver & Reimer 1986), those in Fig. 9 are derived from the probability method (Stuiver & Reimer 1993).

Houlder had himself obtained a date from a bulk-sample of charcoal in hearth 2, Q-387 3094±90bp (1520 – 1050 cal BC)¹ in the upper fills of a quarry pit (Godwin & Willis 1961:73). This he interpreted as Middle Bronze Age squatter occupation utilising a Neolithic quarry. Revisiting this date, UBA-7803, from the same hearth, returned a Neolithic result suggesting that at least some of the material in Houlder's bulk sample was probably residual. But the date from the hearth above this, UBA-7802, does confirm activity in the later Bronze Age.

The dates from Trench 1 show that burning events took place on several separate occasions with the majority of dated samples clustering in the 4th millennium BC, but with subsequent activity in the 3rd and 2nd millennia BC. The range of species dated is also of interest. All of the oak samples belong to the 4th millennium BC hinting at a primary clearance without subsequent regrowth of this species. Hazel and other fast-growing species then dominate the assemblage with birch appearing for the first time in the 2nd millennium BC.

Given the longevity of oak it is possible that the determinations returned from this species significantly overestimate the age at which the wood was burnt (Ambers *et al.* 1999:331). For this reason, UBA-7774, 7776 and 7778 have been included in Bayesian models of the site as outliers and do not influence the posterior date ranges given below.

As noted above, the remaining dates from Mynydd Rhiw East cluster into three discrete chronological episodes (UBA-7779, 7781, 7782, 7801; UBA-7780; and UBA-7777). If these are treated as phases in a Bayesian model, then the 'Neolithic' activity on the hill began between 3758 – 3652 cal BC and ended 3504 – 3115 cal BC with the duration of this activity spanning 167 – 575 years. The new date (UBA-7803) from Houlder's trench indicates that activity took place at this time on both sides of the hill.

There is no evidence for subsequent activity on Mynydd Rhiw until further burning took place in the chalcolithic (UBA-7780). The cairns on top of the hill, just 60m from the excavation trenches, show that the area was then used as a burial place at some time after 2000 BC (not directly dated). The discovery of the jet button in Trench 2 demonstrates that Early Bronze Age activity extended over a wider area than the upstanding archaeology would suggest, and covered part of the old quarries. Further deposits of charcoal both in Trench 1 and in Houlder's area show that the hill was in use again during the Late Bronze Age. The hearths in Houlder's Pit B indicate that some of this charcoal resulted from domestic activities rather than ground clearance.

The presence of Chalcolithic and Late Bronze Age charcoal mixed with Neolithic material in Trench 1 suggests that the ground was dug over on at least one occasion during the Late Bronze Age or later, although it may have been dug over repeatedly both before and after this. There is no obvious explanation for these activities. If building stone had been wanted, there are many surface outcrops of tuffaceous material and scree of dolerite that



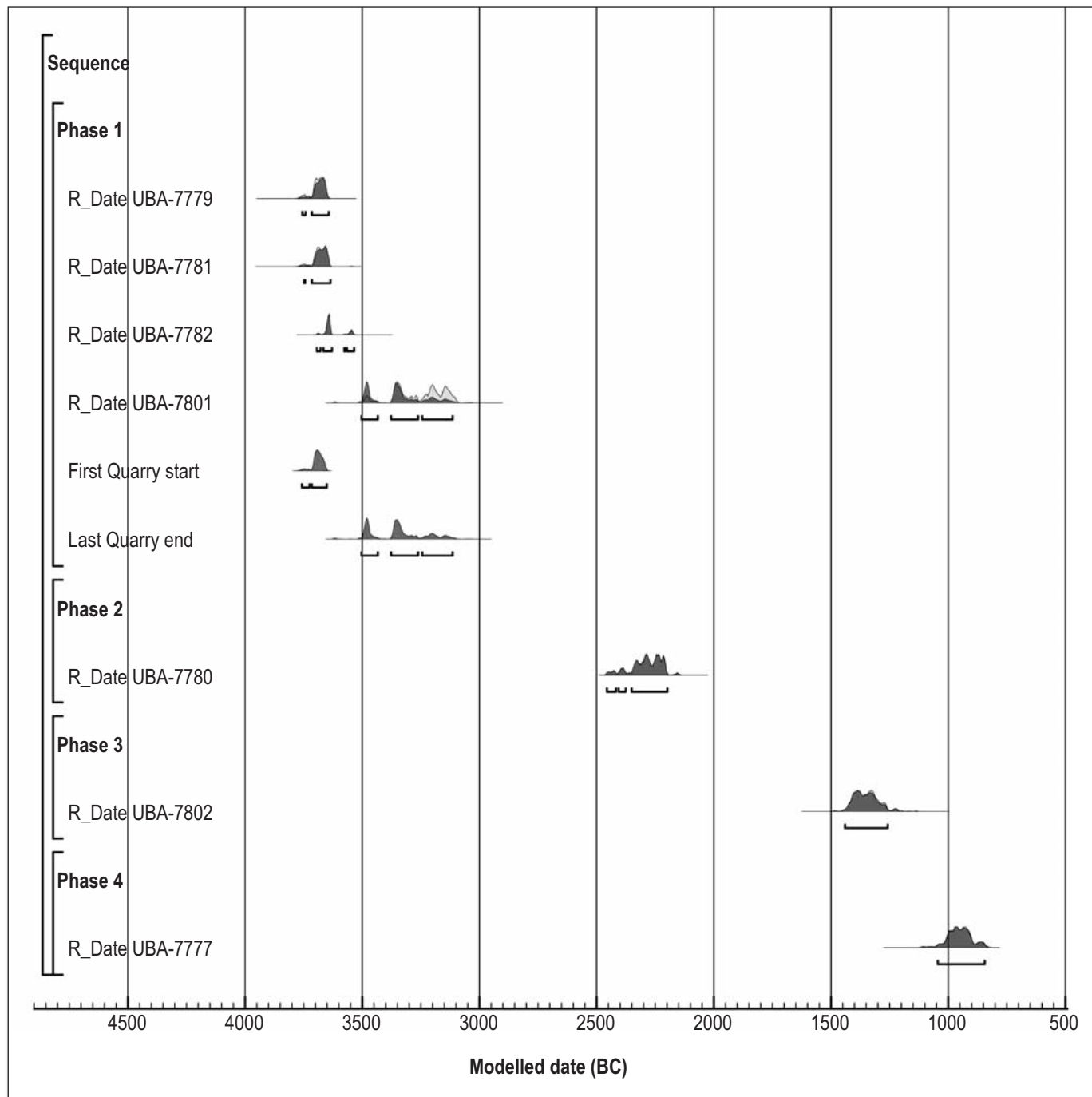


Fig. 9.
Bayesian model showing
calibrated dates from
Trenches 1 and Pit B.

could have been exploited more easily. If the stone had been used in the production of edged tools one would expect to see such artefacts at later sites, which is not the case. In the absence of anthropogenic explanation, consideration should be given to possible natural causes – animal burrows or tree throws – but there is little stratigraphic support for this.

Perhaps a more pertinent question in the current context is: what activities gave rise to the Neolithic charcoal? There was no evidence of firesetting on the exposed bedrock in Trench 1, and the technique would have been unnecessary if the primary goal of the diggers was to

extract loose tufaceous blocks present in the drift. The dated charcoal cannot therefore be taken as a direct proxy for quarrying activity on the site – it is just as likely that it resulted from the maintenance of cleared ground as part of an agricultural regime, as that it represents the remains of the fires of quarrymen. Furthermore, since fire was not essential to the quarry method, it is possible that quarrying may have taken place at times not indicated by the radio-carbon dates.

Discussion

Perhaps the greatest contribution the present study has made to knowledge about Mynydd Rhiw is in our understanding of the scale of quarrying on the hill. Houlder's work suggested a cottage-industry of small-scale quarrying: localised and short-lived. This would make the site comparable perhaps with Nore Down, West Sussex (Barber *et al.* 1999:41), Lambay Island off the coast of Dublin (Cooney 2002), or Carrock Fell, Cumbria (Davis *et al.* 2007).

The present survey indicates that quarrying was widespread across the hill and may have spanned centuries. Its extent cannot be stated definitively but it probably covered around 7.75ha. This makes Mynydd Rhiw more comparable with flint mines such as Grimes Graves (7.6ha) and Martin's Clump (8ha) (Barber *et al.* 1999), although it is still considerably smaller than the quarried areas at Graig Lwyd (Williams & Davidson 2002) and Great Langdale (Claris & Quartermaine 1989). Some re-evaluation of the site's importance within the British Neolithic is therefore appropriate.

Given that quarrying across much of Mynydd Rhiw consisted of earth removal rather than stone cutting, Houlder's suggestion that this may have been conducted as a cottage-industry still holds good. Unless there were social or ritual obligations to be fulfilled before work could commence (cf. Topping & Lynott 2005) then all the quarrying could be accounted for as the result of small groups returning to the site over the centuries on an ad hoc basis. No special skills or teamwork were required, but even this potentially intermittent and uncoordinated activity could have contributed a large volume of material into the Neolithic economy. It is in this area that the new finds from Mynydd Rhiw have most to offer.

When Houlder explored this question in the 1960s petrologists were only able to identify twenty five axes and fragments as probable products of the hill, with the additional proviso that similar geological processes could have produced petrologically similar material elsewhere (Houlder 1961:114, 142–3). Subsequent work has increased this number to 33 out of over 7,800 thin sectioned axes and related items (Clough & Cummins 1988; and see Allen 1990: 171), with Shotton (1988:51) observing a particular concentration in the Herefordshire area. These were not distributed further than South Wales and the Welsh Borders (up to 170km away), and this small scale distribution matched the small scale of the quarry site as it was then known. More recently Heather Jackson has re-

examined the Implement Petrology Committee thin section records in an attempt to find additional matches for the tufaceous sediments quarried on the east side of Mynydd Rhiw. This has produced no new matches and indeed ongoing work has cast doubt on the provenance of some pieces previously identified as being from the hill (Jackson pers comm.). The result is a large quarry area with minimal evidence for exported material – a result which appears anomalous within a research paradigm which emphasises the role that axes served as exchange items (Cummins 1980; Chappell 1986; Darvill 1989; Bradley & Edmonds 1993).

This 'decision' not to export was a choice specific to people around Mynydd Rhiw; just 60km away contemporary communities around Graig Lwyd were adopting a very different exploitation strategy at their mountain (Warren 1921; Williams & Davidson 1998). Axes from here have been found very widely dispersed at both earlier and later Neolithic sites across southern Britain (Burrow forthcoming). Indeed, Graig Lwyd axes are even found on the Llyn peninsula not far from Mynydd Rhiw, demonstrating that some people in this area were not adverse to using the axes of their neighbours. It could be argued that the different geological positions of the two sites could account for the different uses to which their resources were put. Today, Mynydd Rhiw seems remote, set as it is on the end of a peninsula, while Graig Lwyd is close to the Conwy Valley which affords easy access to southern Britain. But both sites are easily accessible by sea, a point demonstrated at Mynydd Rhiw in the nineteenth century, when the area was the centre of a manganese mining industry, the products of which were exported by sea to northern England (Rhiw.com nd). Geography does not account for the limited distribution of Mynydd Rhiw material, raising the possibility that cultural factors may have played a part.

Although few Mynydd Rhiw axes are found far from the site, a scatter of material – flakes, blocks, small tools and axes – have been found within a day's walk from the hill (Dave Chapman pers comm.), see *Fig. 10*. This evidence suggests that the hill was used by communities living within easy reach of it, with their use of the stone being geared to their own specific need for tools rather than with a view to exchange. At one level this is a bland and utilitarian interpretation with little to offer wider discussion of inter-regional contact in the British Neolithic, but it may serve to place such studies into perspective. Not all communities need have been concerned with links to peo-



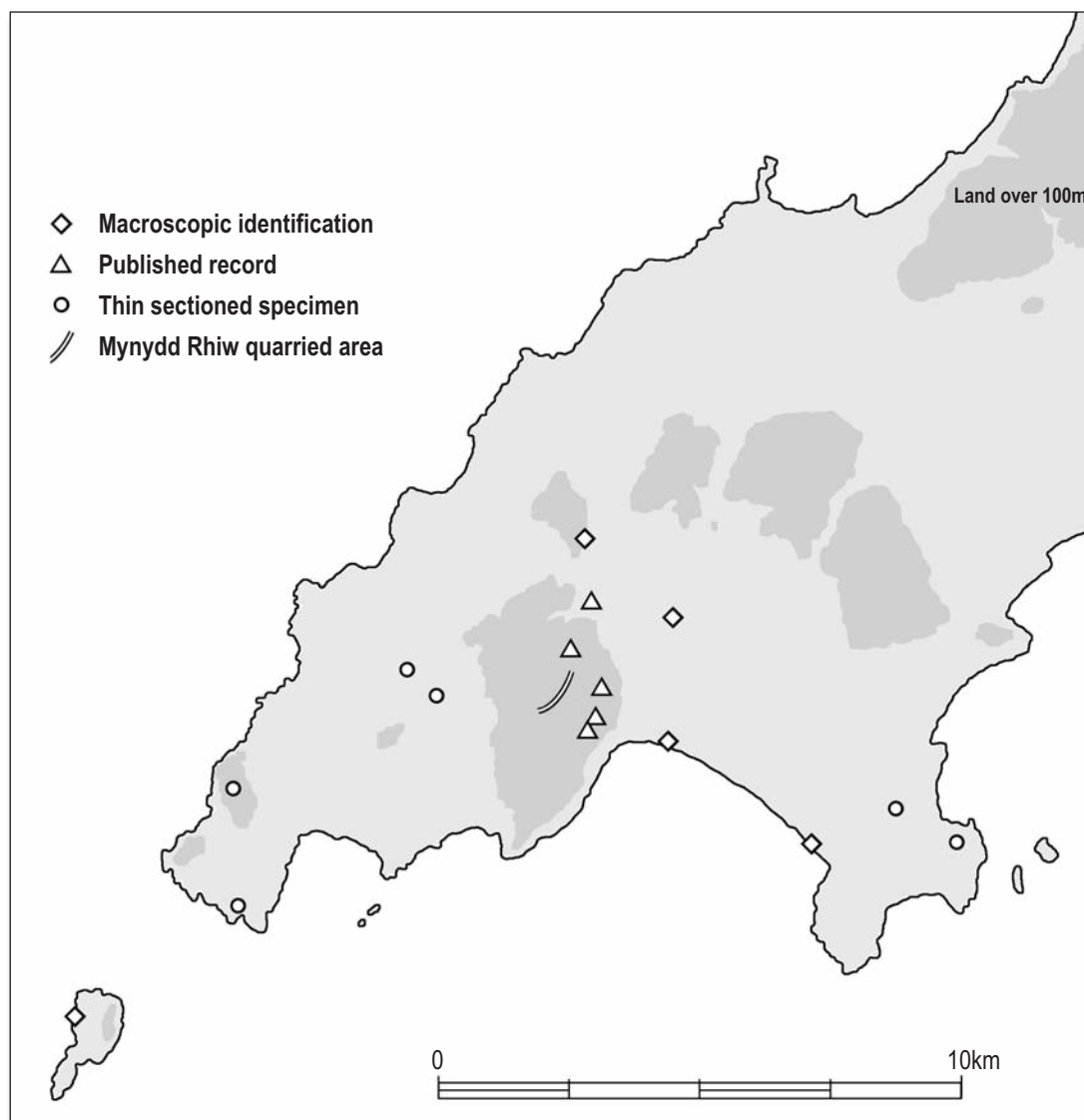


Fig. 10.
Findspots of
Mynydd Rhiw (and
probably Mynydd Rhiw)
material from the
Llyn peninsula.
The known distribution
shows a marked bias
towards the southwest
within easy reach of
the quarry site.

ples far away, some may have rooted their identity in more local surrounds, although this need not mean that they were oblivious to the wider world. Going further, some identities may have been formulated in opposition to wider relationships, as has been argued for the later Neolithic on the Isle of Man (Burrow 1999).

In the case of Mynydd Rhiw, the hill may have acted as a focal point for local communities, giving a common sense of identity to those who lived nearby and who had the right to use its contents. This shared use of the distinctive tufaceous rock may have acted as a symbol through which locals reinforced their difference from people in neighbouring areas. If this was the case, the few Mynydd Rhiw axes found further afield may be seen as evidence of a failure to control the mountain's 'wealth' completely, rather than as a positive contribution to socially-binding exchange networks.

Notes

- 1 Published as Q-387a 3155±110bp and Q-387b 3012±110bp in Houlder (1961, 141).

Acknowledgements

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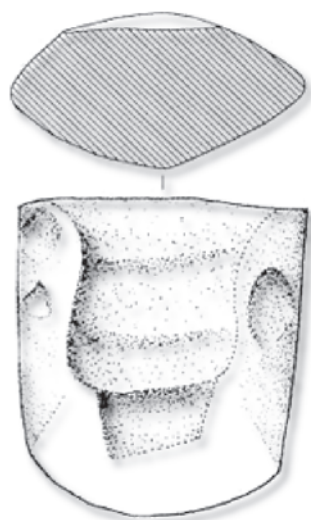
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Graig Lwyd (Group VII) assemblages from Parc Bryn Cegin, Llandygai, Gwynedd, Wales

– analysis and interpretation

Abstract

This paper builds upon the results of recent work on and around the important (Group VII) source of stone axes at Graig Lwyd, North Wales. In particular, it uses the evidence from recent excavations at Parc Bryn Cegin to explore Neolithic attitudes towards axe blades and the stone from which they were made. Close analysis of the debitage from Parc Bryn Cegin and other sites suggests that individual blades were sometimes deliberately broken and reduced. The paper concludes with speculation on what this act may have meant to people at the time.

Introduction

The outcrops of augite granophyre located at Graig Lwyd, North Wales, have long been recognised as one of the major sources of stone axes in Britain. Early investigations at the source were followed by distribution studies which confirmed that axes from these outcrops, designated Group VII, circulated over much of southern Britain during the Neolithic (*Fig 1*). The number of axes attributable to the source continues to grow each year, particularly with the advent of commercial archaeology in Wales and England. Commercial excavation has also provided insights on the chronology, context and treatment of blades and raw material, and on the attitudes that shaped how that material came to be deposited. Nowhere is this clearer than at Parc Bryn Cegin, Llandygai, where survey and excavation (Kenney 2008a and b) within a few kilometres of the source has produced Early and Late Neolithic assemblages of worked Group VII stone.

Parc Bryn Cegin occupies the brow and lower slopes of a north facing ridge and overlooks on its northern perimeter the important henge complex of Llandygai (Lynch & Musson 2001) (*Fig. 2*). It is assumed that activities on the ridge and at the monuments were intimately interconnected, at least for part of the sequence. The ridge of Bryn Cegin commands an impressive vantage in the landscape, affording on its northern front clear views to the Menai Strait and beyond to the low lying island of Môn (Anglesey). On its southern side, it enjoys panoramic vistas of the mountains of Eryri (Snowdonia). Immediately to the east and at a distance of 16 kilometres lies the severely truncated headland of Pen Penmaen. This hill has been significantly reduced by modern quarrying, but during the Neolithic, at a time contemporary with activity at Parc Bryn Cegin, it was a prominent feature, a dome shaped eminence rising to an original height of 472 metres. It was prominent in other ways as well, the outer margins of this igneous intrusion providing the source of the augite granophyre that was favoured for the production of Graig Lwyd, Group VII, axes.

On the north western slope of Parc Bryn Cegin, a large early Neolithic timber structure and an adjoining pit were excavated in advance of development. These features contained a significant assemblage of Graig Lwyd lithics. Along the crest of the ridge demarcating the eastern side of the site, a series of pit groups, dated by C14 assays to later stages in the Neolithic, were also located, while a smaller

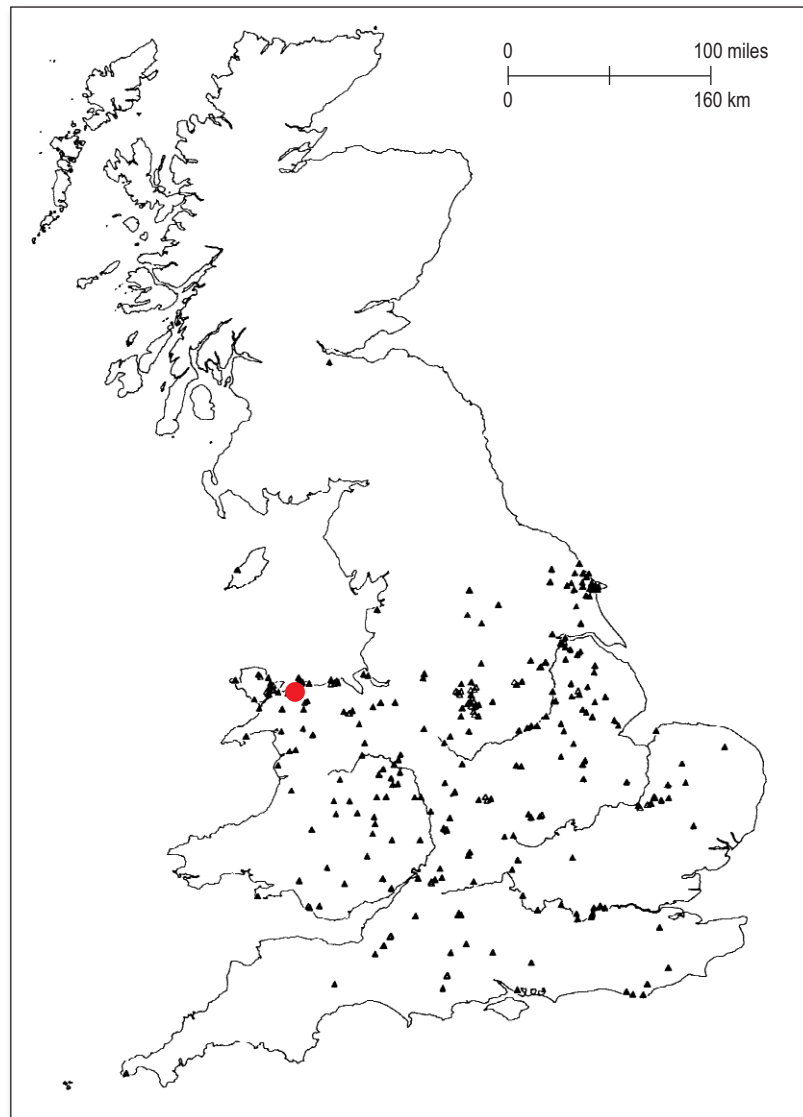


Fig. 1.
Distribution of Graig
Lwyd (Group VII) lithics.

group, of equal interest, was excavated in close proximity to the timber structure. The location of these features is shown in *Fig. 3*. The seven principal pit groups (I–VI and VIII) consist of a complex of small sub-pits, each containing deposits of pottery sherds, flint debitage, quartz fragments, bone, charcoal and organic debris, mostly in the form of charred hazelnut shells. Graig Lwyd material occurs in five of these features. A detailed description of the assemblages associated with the above features, and the series of C14 dates which provide the chronological framework for Parc Bryn Cegin, are published in the excavation report (Kenney 2008a and b information summarised here in *Table 1*). In what follows, the character and immediate context of the Group VII material from the site is described in some detail. These descriptions, in turn, inform wider discussion on the chronology of working at the source, and on the attitudes that shaped how finished axes were treated and deposited over time.

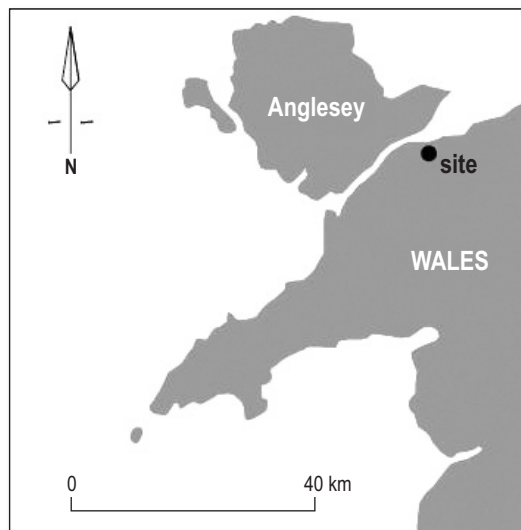


Fig. 2.
Location of Parc Bryn
Cegin and principal sites
mentioned in the text.

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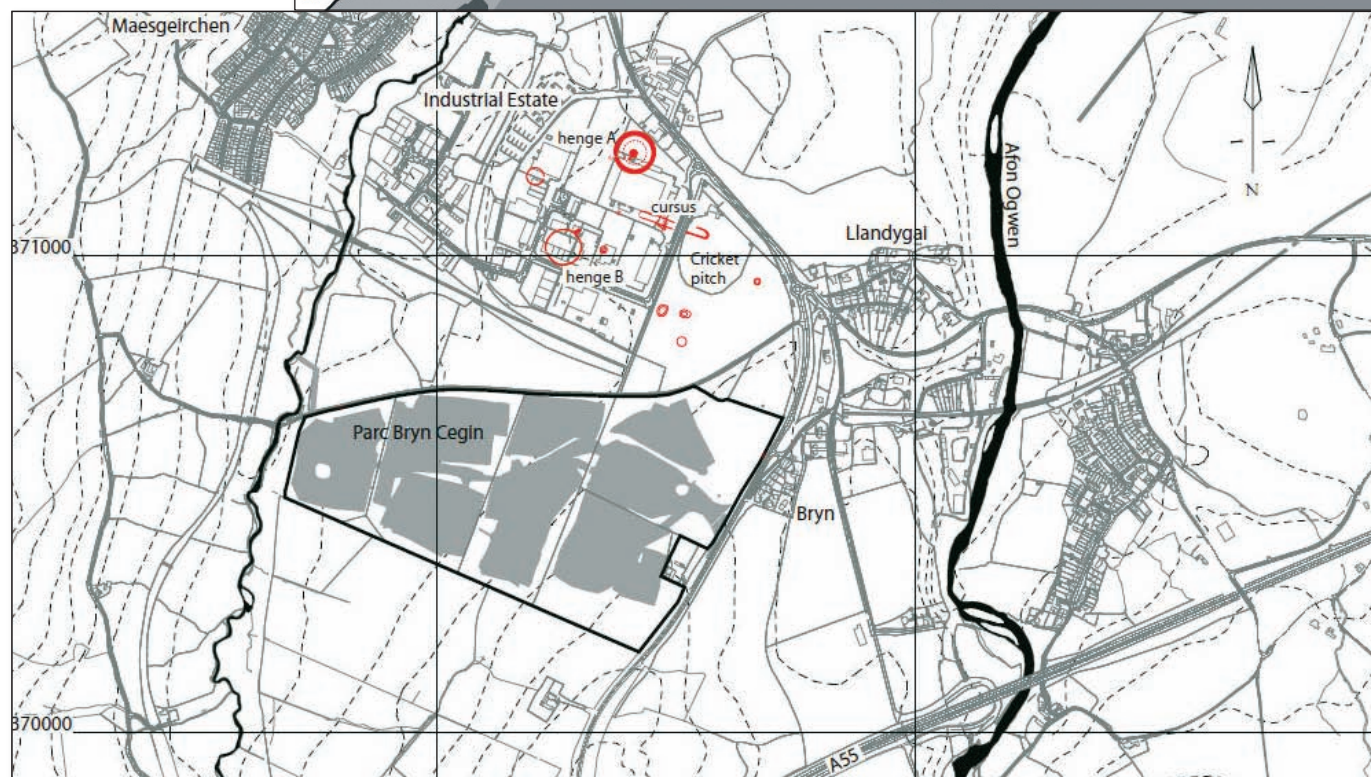
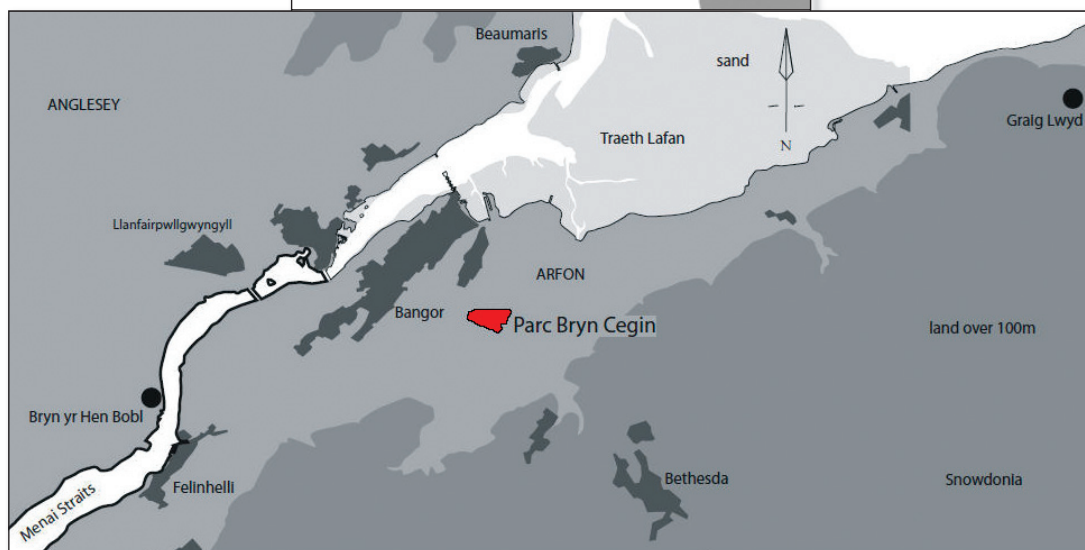




Fig. 3.

Plan of excavations
at Parc Bryn Cegin.
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Table 1. Bryn Cegin and Llandygai I site contexts and C14 dates.

The date for the Early Neolithic structure is for the use of the structure as produced by Bayesian analysis of 14 radiocarbon dates expressed at 68% probability (for a detailed discussion see Marshall in Kenney 2008b). Dates for the pit groups are quoted at 95% confidence limits, and where there are more than two dates for a pit group the earliest and the latest are given. All other dates are at 95% confidence limits. For more details on the Parc Bryn Cegin dates, including laboratory numbers see Marshall in Kenney 2008b.

Site	Feature type	Context	Diagnostic typological association	Graig Lwyd lithic/s	C14 date BC cal	Reference
Parc Bryn Cegin Pit Group I	pit	formal deposit	Mortlake + early Neolithic plain ware	29 flakes plain 6 flakes polish	3360–3090 and 3330–2920	Kenney 2008b
Parc Bryn Cegin Pit Group III	pit	formal deposit	Fengate	5 flakes plain	No date	Kenney 2008b
Parc Bryn Cegin Pit Group V	pit	formal deposit	Fengate	1 flake plain	3350–3020	Kenney 2008b
Parc Bryn Cegin Pit Group VI	pit	formal deposit	Fengate	4 flakes plain	3340–3020 and 3360–3090	Kenney 2008b
Parc Bryn Cegin Pit Group VIII	pit	formal deposit	Grooved Ware	1 flake polished 1 axe core	2900–2670 and 2880–2580	Kenney 2008b
Parc Bryn Cegin Timber Structure	posthole/pipe	domestic?	Early Neolithic plain ware	8 flakes plain 2 flakes polish	Start 3760–3700, end 3670–3620	Kenney 2008b
Parc Bryn Cegin Pit 1729	pit	casual deposit	No associated objects	1 flake plain 2 flakes polish	No date	Kenney 2008b
Parc Bryn Cegin Pit 1647	pit	casual deposit	No associated objects	18 micro-flakes	No date	Kenney 2008b
Llandygai I Henge B	pit FB 151	formal deposit	Petit tranchet flint arrow	7 flakes plain, 4 flakes polish, 1 half axe fragment	2880–2570	Lynch and Musson 2001
Llandygai I Henge A	sealed surface below bank	–	No associated objects	1 flake plain	3340–2920	Lynch and Musson 2001
Bryn yr Hen Bobl, Llanidan	pre-terrace surface?	domestic / formal	Mortlake / Fengate	81 flakes plain, 7 flakes polish, 3 scrapers	No date	Hemp 1935, Gresham 1985
Bryn yr Hen Bobl	megalith tomb	burial	No objects	No objects	2300–2030	Hemp 1935, Gresham 1985

Graig Lwyd (Group VII) lithic assemblages at Parc Bryn Cegin

1. The early Neolithic timber structure and contemporary pit

A total of 10 Graig Lwyd lithics were recovered from within the timber structure. The assemblage occupied various primary features, such as post holes, post trenches and post pipes, which delineated a structure that covered an area of approximately 100m². Included in this assemblage are one large, thick and heavily calcined reduction flake (No511), two small transversely struck secondary reduction flakes, two narrow longitudinally struck thinning flakes and five small trimming micro flakes/chips with angled platforms (*Fig. 4: SF1167 and SF1225*). One of the thinning flakes, and one micro flake, retains a ground and polished surface. Outside the building pit 1619, situated five metres from the western end, contained the upper butt half of a ground and polished axe that had been calcined and fire cracked. Analysis of the axe has shown it to be made of Ordovician volcanic tuff from an unknown source (Jackson 2008).

2. The later Neolithic pit groups

Five of the pit complexes at Parc Bryn Cegin contained Graig Lwyd lithics which in total account for a sample of 49 pieces. The pits are located on the higher ground, with the exception of pit group VIII which lies near the aforementioned timber structure. The pits and their assemblages are summarised in *Table 1* and may be accounted in greater detail as follows.

Pit group I

A series of six small sub-pits comprise the group and combined they have produced the largest collection of Graig Lwyd lithics on site, numbering 35 pieces. In general the lithics are made on a coarse grained facies of the parent rock. The collection consists of the following objects.

- 1) Block and block fragments, numbering two pieces. One fragment could be interpreted as an axe sharpening tranchet flake (*Fig. 4: SF2*); the second is a thick, unpolished, core reduction flake displaying convergent flake facets (L=70mm;W=55mm) which may be a remnant axe fragment (*Fig. 4: SF1321*).

Fig. 4.
Examples of polished
Graig Lwyd pieces from
Parc Bryn Cegin.

SF1097 and SF1341
are first removal ovoid
medallion-type flake from
a polished object;

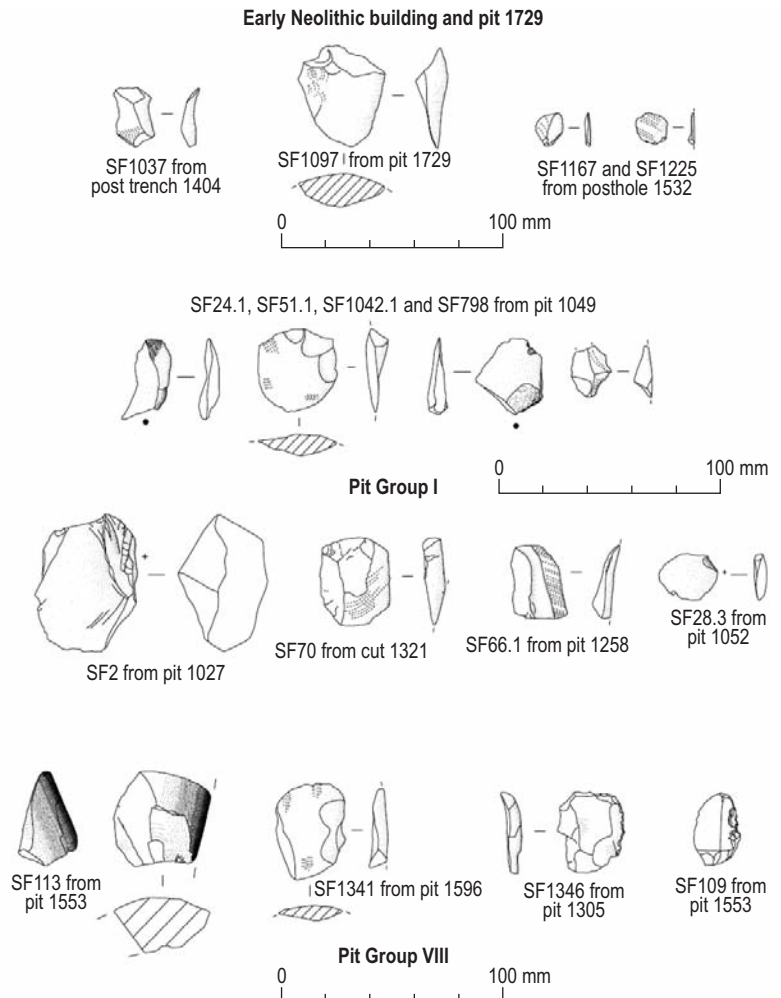
SF113 and SF70
are polished axe
fragments;

SF24.1, SF28.3, SF51.1,
SF66.1, SF798, SF1037
and SF1042.1
are reduction flakes
with polish;

SF1167 and SF1225 are
micro flakes with polish;

SF2 is a large reduction
flake possibly a tranchet
axe sharpening specimen.

SF109 and SF1346 are
respectively a retouched
flake and a crude side
scraper both made on a
non Graig Lwyd stone
similar to the Mynydd
Rhiw source (Group XXI).



- 2) Transverse and longitudinally struck reduction flakes, numbering five pieces. Of the two transverse flakes one is the best example in the collection of a secondary axe trimming flake struck transversely from a wide faceted platform with the width ratio greater than its length (W 65mm; L=32mm); the two secondary reduction flakes have shortened truncated bodies; the fifth fragment is a small, thick reduction chunk.
- 3) Thinning/trimming flakes, numbering four examples. Included are examples of thin wasting flakes struck longitudinally. The largest flake measures 57mm in length. Small trimming flakelets – eight in number – and 10 micro chips may also be added to this group. Most of the flakelets have been struck from narrow angled striking platforms.
- 4) Thinning flakes with polished surfaces, represented by five specimens and one flakelet. The flakes vary in length between 40mm to 35mm and have been struck from narrow, horizontal striking platforms. Two flake shapes are represented, one a narrow 'blade' type (two examples), the other an ovoid medallion type (three examples). Two of the ovoid flakes are the first removals from a ground and polished object, whilst the other three retain remnants of the polished surface.

Pit Group III

This group has three sub-pits and five examples of Graig Lwyd rock debitage were present. Of the latter one fragment is a truncated, longitudinally struck thinning flake; one a small trimming flake; and the remaining three micro chips. Polished surfaces are not observed in the group.

Pit Group V

A single small pit produced one unpolished chip of Graig Lwyd rock.

Pit Group VI

The group includes 10 sub-pits in which four fragments of Graig Lwyd rock were deposited. The Graig Lwyd objects include a large (L=45mm, W=43mm), rectangular, truncated, reduction chunk displaying numerous flake removals; a narrow thinning flake retaining a small portion of cortex; two micro chips. Examples with polished surfaces are not present.

Pit Group VIII

Six pits placed in a rough oval arrangement and lying to the south west of the timber structure constitute this group. Only two fragments of Graig Lwyd rock were included but both are of great interest. The first (*Fig. 4: SF113*) is a roughly rectangular fragment (L=45mm; W=45mm) retaining on its curved edge and flat face significant evidence of a ground and finely polished surface. Two large flakes have removed the greater part of the upper (?) surface and a transverse single fracture has truncated all the dorsal side of the object. The fragment clearly represents the much fractured remnant of a larger object which has been forcibly broken. The second object (*Fig. 4: SF1341*) is a large (L=43mm, W=30mm), ovoid, medallion shaped flake bearing irregular traces of a ground and polished surface. The flake has a steep angular platform and represents the first removal from a polished object.

Two other flakes were also present in pit group VIII. X-ray diffraction showed these to be similar to material from Mynydd Rhiw (Group XXI) in the Llŷn Peninsula but not definitely attributable to this source (Jackson 2008). Both are interesting since they are the only retouched examples in the whole of the non-flint lithic corpus on site and may be classified as crude, but serviceable, artefacts. One is a poorly constructed side scraper on a thick, cortex bound flake (*Fig. 4: SF1346*) and is present in a sub-pit with featureless pottery sherds, flint, charcoal and hazelnut shells. The second specimen is a thin, cortex bound shaping flake with a slightly retouched edge (*Fig. 4: SF109*) and is associated with the aforementioned rectangular fragment bearing polished surfaces.

3. Assemblages from undated pits in close proximity to the timber structure

Pit 1729 is situated approximately 16 metres due west of the timber structure and contained a large (L=45mm), ovoid shaped flake, with a ground and polished surface (*Fig. 4: SF1097*), in association with a small unpolished reduction flake. Pit 1647 lies four metres from the western end of the timber structure and included circa 18 micro flaking chips which were recovered by sieving the infill of the pit.

Chronology and history

The contexts and associations of the Group VII assemblage from Parc Bryn Cegin go some way towards providing a chronological framework for the use of the source. Craig Lwyd was the

Fig. 5.
The extent of the
Penmaenmawr Igneous
Intrusion.

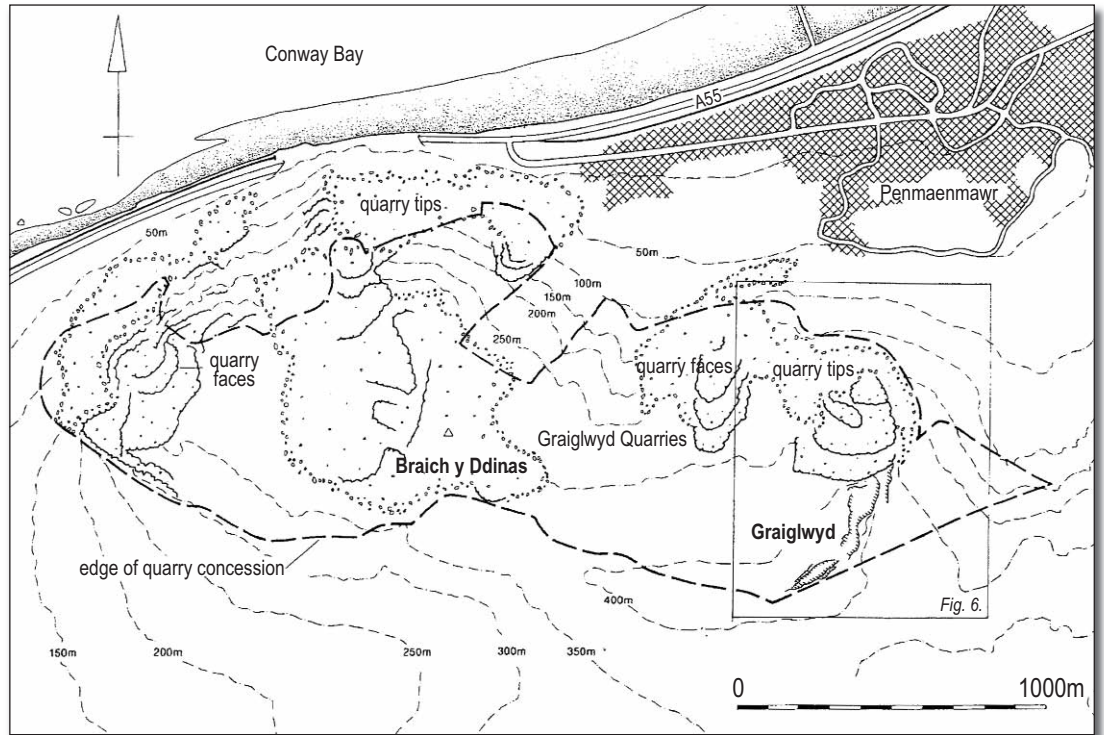
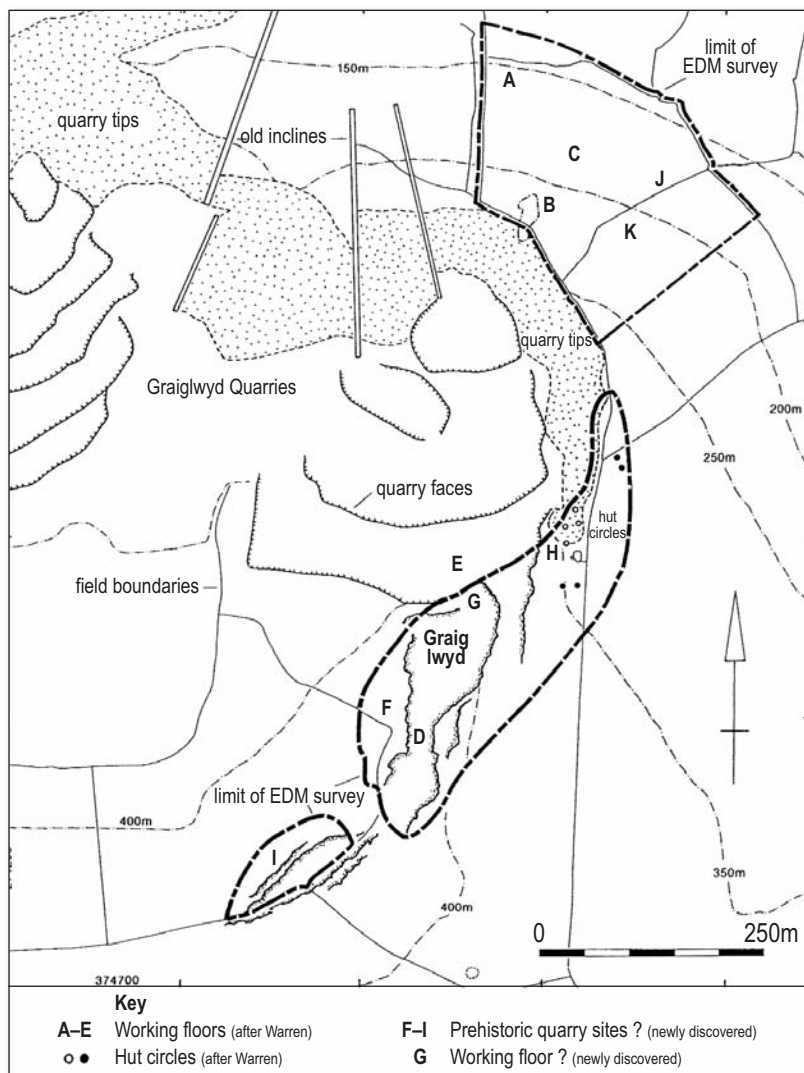


Fig. 6.
The location of the Graig
Lwyd outcrop and the
principal surveyed sites.



second site of its type to be identified, Tievebullagh in County Antrim, Ireland being the first. The discoverer, Hazzeldine Warren, investigating the site through extensive survey and excavation, published a series of papers (1919, 1920, 1922; Williams 1998) detailing the extent of the operation at the core site of the Graig Lwyd in Penmaenmawr (Fig. 5) and in the two adjoining locations of Dinas (SH 700738) and Garreg Fawr (SH 692731) in Llanfairfechan. The Graig Lwyd has been extensively damaged by modern quarrying (Fig. 6), a critical situation that demanded reassessment of the site in a series of survey and limited excavation campaigns conducted between 1992 and 1994 (Williams & Davidson 1998, 2002). One of the principal objectives of the survey was to obtain a series of radiocarbon dates from selected locations where small scale, exploratory excavations were conducted. Unfortunately, this goal could only be partly achieved. Excavation of site B, where Warren (1921) had reported the presence of abundant flaking debitage in association with hearths, proved fruitless, since his extensive trenching had removed all the primary evidence without a detailed record. However, an undisturbed baulk protected by a stone wall on the north side of his excavation, and at a point detailed in a photograph of Warren at work in 1919 (Williams & Davidson 1998:Plate 1), produced sufficient flecks of charcoal on a cache of fresh flakes to give a date of 3110–2910 cal BC (Williams & Davidson 1998:10–12). No charcoal



was present at site F, the important summit location where excavation showed that primary extraction of the rock had been undertaken (Williams & Davidson 1998:12–16). However, investigation of an undisturbed deposit containing a cache of fresh flaking debitage, underlying a small cairn (Cairn 67) situated c.300 metres west of the Graig Lwyd outcrops, produced a date of 4350–3990 cal BC (Williams & Davidson 1998:18–19). Both dates will be further discussed below.

Axe factory sites are principally dated from their products, as discovered in dateable contexts at distant locations within their distribution spheres (Clough & Cummins 1979: 246–80). With a few exceptions, dates from the sources themselves are relatively thin on the ground (Bradley & Edmonds 1993; Burrow this volume; Edmonds *et al.* 1993). Isobel Smith (1979) originally noted five Graig Lwyd associations from various locations in southern England and Fiona Roe (1999 and forthcoming) has added significantly to this list (Table 2). Many of the fragments recorded by Smith and Roe appear to have been deliberately deposited in pits associated with Grooved Ware, worked flints, animal bone and ashy material often rich in charcoal. The association of some of these pits with formal or ceremonial enclosures, particularly henges, pit circles and alignments, is also a notable feature.

As Table 2 indicates, the dating of Graig Lwyd material has been either directly by radio-carbon assays, or by context and association. The confidence we can attach to these dates is

thus, inevitably, variable. At Barholm in Lincolnshire for example (Simpson *et al.* 1993), the presence of Grooved Ware in a number of the pits defining the site suggest activity in the later Neolithic. It is therefore assumed that a similar date can be assigned to the Group VII fragments also found on site. However, neither of the two pits within which Graig Lwyd stone was found contained any Grooved Ware. As elsewhere (e.g. Down Farm, Dorset; Barrett *et al.* 1991a; Cleal 1984), degrees of association tend to vary, and though circumstantial dating evidence points to a link with Grooved Ware during the period of c.2800–2400 BC (Gibson & Kinnes 1997), this is something that we need to demonstrate rather than assume *a priori*. This is where the dating evidence from Parc Bryn Cegin is so important. Comparable dates have certainly been recovered, and on Graig Lwyd material in direct association with Grooved Ware, in Pit Group VIII, which returned a date of between 2900–2670 cal BC and 2880–2580 cal BC (Table 1). However, the site has also produced significantly older deposits and associations. In a total of three pit groups (I, III and V) Group VII debitage is accompanied by mid Neolithic Peterborough Ware pottery (Table 1). These deposits are dated to between 3360–3090 cal BC to 3330–2920 cal BC, which corresponds with the upper limits of the date range ascribed to Peterborough Ware forms in Wales (Gibson 1995). While across the country there is considerable overlap between Grooved Ware and Peterborough Ware chronologies, the dates from Parc Bryn Cegin show very little overlap,

Table 2.
Graig Lwyd objects
from outreach locations
in the British Isles.

Site	Feature type	Context	Diagnostic typological association	Graig Lwyd lithic/s	C14 date BC cal @ 95% confidence	Reference
Gussage St Michael, Down Farm, Dorset	henge?	pit 7 pit 11A pit 32	Grooved W – –	axe no object no object	no date 2890–2570 2870–2480	Roe 1999, 231, 233
Barholm, Lincolnshire	henge?	pit 24 hollow 8 pit 4 pit 13	Grooved W Grooved W – –	axe axe no object no object	no date no date 3350–2550 3350–2450	Roe 1999, 232, 233
West Kennet Avenue, Avebury	avenue	pit 1 pit 10	Grooved W transverse arrowhead	axe fragment axe fragment	no date	Evens, <i>et al.</i> , 1972, 253
Woodlands, Amesbury, Wiltshire	pit circle?	pit 3	Grooved W + transverse arrowhead	axe fragment	no date	Evens, <i>et al.</i> , 1972, 253
Windmill Hill, Avebury	causeway enclosure	upper ditch fill	?	axe?	no date?	Smith 1965
Cairnpapple West Lothian	pre-henge	pit deposition of earlier Neolithic	early Neolithic plain bowl pottery	axe fragment	no date	Piggott 1947/48, 102
Swaffam Engine Drain, Swaffam Prior, Cambridgeshire	Fen Clay formation	single find	–	axe	c2700BC position relative to Fen Clay formation	Smith 1979, 19
Shapwick Heath Somerset Levels	section in peat	single find	–	axe	c2580±130 peat sample near find spot	Smith 1979, 19

supporting the primacy of Peterborough styled ceramics in the second half of the fourth and the first quarter of the third millennium BC. Site B at the Graig Lwyd (3110–2910 cal BC) would have seen stoneworking at this time and could have served Parc Bryn Cegin and other sites in the immediate locality, such as Bryn yr Hen Bobl and the Llandygai I henges (*Table 1*).

The rectangular timber structure in Trench 1 pushes the chronology still further back. Dispensing with the erroneous claim (Smith 1979) that such flakes were present in primary contexts in the Llandygai timber structure (Lynch & Musson 2001:35), this is the first documented association of a timber building with material from Graig Lwyd. Fourteen samples of short-lived species from the timber structure were dated and analysed using Bayesian statistics to give a period of use of between 3760–3700 cal BC and 3670–3620 cal BC. As many of the Graig Lwyd pieces were found in secure contexts directly related to the structure, particularly postholes, this establishes one of the earliest known dates for the Graig Lwyd axe source in the first half of the fourth millennium, making it contemporary with some of the earliest Neolithic monuments in Wales and elsewhere in the British Isles.

The date range for Graig Lwyd material at the site can be closely compared with the sequence obtained in the vicinity of the Group VI/XI source around Great Langdale, Cumbria. In this case, much more of the exploited outcrops survive to be investigated, with the result that fieldwork over the past two decades or so has seen the recovery of a number of samples of dateable material. Overall, the dates here confirm that the making of axe blades was also underway from at least the very early fourth millennium and continued throughout most of the Neolithic (Bradley & Edmonds 1993; Davis & Edmonds this volume). Whether or not this persistence was a characteristic of all known stone sources is debateable. At Creag Na Caillich (Group XXIV) and Mynydd Rhiw (Group VIII) for example, what dating there is suggests that many evidently smaller sources were visited and exploited over shorter sequences (Burrow this volume; Edmonds *et al.* 1993). What is not clear is whether or not such shorter sequences reflect late initiation or a cessation of activity after no more than a few centuries. On this, the evidence is equivocal; fourth millennium origins can be demonstrated for working at Mynydd Rhiw, while other sources, where we have evidence at all, return dates in the first half of the third millennium. There is much here that we do not yet know. Dates from

sources remain few and far between and without detailed chronologies, there is little basis for understanding axe sources as a specific historical phenomenon. Neither is it possible to infer much about the *scale* of working, beyond suggesting that it was often a periodic event that required a journey up to the stone. As with the flint mines of southern and eastern England (Topping & Lynott 2005), it may be best in the meantime to anticipate a measure of variability in the evidence, differences from one source to another arising from the regionally varied historical conditions in which they emerged.

What is clear is that the range of early dates for Graig Lwyd stone, like those from Cumbria, challenges some fundamental assumptions regarding the character and origins of the Neolithic itself. Echoing patterns seen elsewhere in the Irish Sea zone (e.g. Cooney *et al.* this volume) both sequences demonstrate that the practice of travelling to distinctive outcrops to obtain stone for axe blades was not simply a *secondary response* to the demands of farmers, an industry growing up after the *prior* establishment of an agricultural way of life. In fact, it was there from the beginning, a primary feature of what we call the Neolithic and important in its own right for reasons that were probably as much social as they were practical. Indeed, if the earliest date from beneath cairn 67, is accepted, then it could be argued that certain practices that we recognise as Neolithic were established significantly earlier than others. However, assumptions based on a single date must be viewed with extreme caution. The area where this small cairn is located, in the central depression of the main igneous mass of the Penmaenmawr intrusion, is potentially significant and the intriguing association of flaking debris with the cairn, as well as the early date, makes future investigation of this area a priority. It is possible that the cairn surmounts a buried landscape that lies within the area defined by the high quality rock of *Y Graiglwyd*; which may be literally translated to mean the *Grey Rock* or even the *Dappled Outcrop* (Williams & Davidson 2001).

The significance of stone

The material from Parc Bryn Cegin demonstrates a persistent attention paid to the *Grey Rock* over a considerable period of time. What it also reveals is a form of treatment which suggests that axes, and perhaps even the stone itself, were often held in a very particular regard, valued in a way that required specific forms of attention.



One of the characteristics that make these assemblages so interesting is that they contain very few objects generated during the making of axe blades. In the entire corpus, such flakes account for no more than an estimated 7%. With a few possible exceptions, large primary reduction flakes are all but absent, while secondary reduction and thick thinning flakes number no more than six specimens. Included in this group are the two transversely struck examples which most likely represent a delicate, late removal in the axe flaking sequence. Fine thinning and secondary shaping flakes, characterised by their thinness and curved profiles, are noticeably absent from the sample, as indeed are spalls or trimming chips with similar typological features. The combined evidence from both the early Neolithic structure and the later Neolithic pits would suggest that primary flaking leading to the making of roughout axes was not generally undertaken at Parc Bryn Cegin. Overall, the emphasis appears to have been less upon production and more upon destruction; the taking apart of axes, rather than their fabrication.

This destructive sequence is best documented in the three pit assemblages that contain flakes with polished surfaces. The most significant fragment is the remnant chunk of a polished axe from Pit Group VIII (No 113). Of equal significance in the same Pit Group is the ovoid-shaped flake (No 1341) that has top sliced the face of a similar ground and polished artefact, presumably an axe. It is likely that these flakes come from different artefacts. The same 'top slicing' phenomenon is again illustrated in the three 'medallion'-shaped flakes from Pit I, and in the single identical flake from the undated pit 1729, located 16 metres west of the post structure. All the other flakes of less determinate shape displaying polished surfaces, particularly the micro chip from within the timber structure, document the same destructive process, as indeed must many of the finer unpolished flakes, flakelets and micro chips from the two principal localities on site.

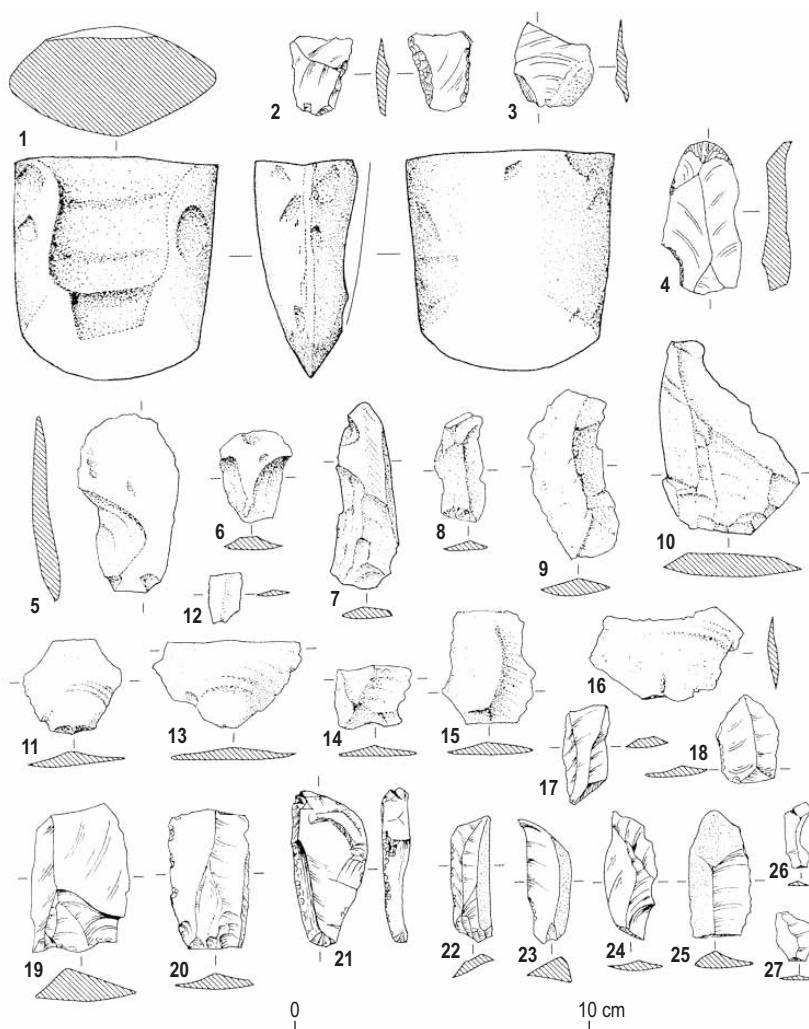
An equally effective, but totally different, destructive process is evident on the butt half fragment of the ground and polished axe in pit 1619. This had been calcined to a point of almost total disintegration before being committed to the pit with an associated assemblage of early Neolithic pottery, flint and quartz debitage. The combined evidence of the polished and unpolished debitage, both represented by objects grading in size from flakes to microchips, strongly suggests that the fragmenting of polished axes may have been undertaken at Parc Bryn Cegin.

A similar destructive episode can be inferred from evidence in the adjoining henge complex at Llandygai and specifically in Pit FB151, which lay near the inner edge of the ditch in Henge B (Lynch & Musson 2001: Figs. 24, 35). This ditch had truncated part of an early Neolithic timber structure which, incidentally, was situated approximately five metres distant from the above pit, a position that is startlingly reminiscent of the distance separating Pit Group VIII from the timber structure at Parc Bryn Cegin. The deposition in Pit FB151 included the blade end of a truncated Graig Lwyd axe, the polished surface of which had been breached by two flake removals, the last approximating to a 'medallion' shaped flake (Fig. 7: 1). Also present were four Graig Lwyd flakes with polished surfaces (Fig. 7: 5–8), one of which is of the ovoid first removal type but, incidentally, not the one flaked from the axe (Fig. 7: 5), and seven unpolished Graig Lwyd trimming flakes (Fig. 7: 9, 11–16). Of the latter, six are sharply truncated, recalling the form of some of the flakes in Pit I at Parc Bryn Cegin. Pottery was not present in the deposit, but the pit has a C14 assay of 2880–

Fig. 7.
The contents of pit FB 151
at Henge B, Llandygai.

Blade fragment of
Graig Lwyd axe (1);
Graig Lwyd reduction
flakes with polished
surfaces (5–8) – note
specimen (5) as a first
removal flake
approximating to the
ovoid medallion-type;
unpolished Graig Lwyd
reduction flakes (9, 11–
16); struck and utilized
flakes of flint (3, 17–27);
unpolished flake of fine
grained tuff (10).

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2570 cal BC, placing it approximately coeval with the Grooved Ware associated Pit VIII at Parc Bryn Cegin. It is therefore apparent that the axe destruction or *exfoliation* process was being undertaken at both monuments contemporaneously. The disaggregated Graig Lwyd lithics from pit FB151 at Llandygai represent a closed assemblage that was consigned to the pit within a brief period, possibly even a singular occasion. However, the C14 dates from the Parc Bryn Cegin pits indicate that overall, these acts of deposition happened over a protracted time range (see above).

It is one thing to identify an emphasis upon destruction rather than production, but quite another to establish why certain stone blades were taken apart in these ways. One obvious suggestion would be that old blades might see further use as cores from which serviceable flakes and other tools could be struck. This does not seem to have been the case. Across all of the Graig Lwyd assemblages described here, with the exception of the heavily calcined flake (No 511), all individual specimens retain their fresh, sharp edges. Not a single flake has been retouched or modified to form a serviceable artefact and none show any other macroscopic signs of use. In this capacity, the Parc Bryn Cegin and Llandygai evidence fits into the wider spectrum of sites in northern Wales, where artefacts made from Graig Lwyd flakes are practically absent. Excavations around the source itself revealed large dumps of waste debris in a number of locations and it remains a mystery why such an easily accessible source of flaked material was not utilized (Williams & Davidson 1998). Warren (1922) also noted the very limited number of utilized flakes in his excavation of site B at the Graig Lwyd, recording only three large scraper like objects (*ibid.*: Fig. 14, 12.1–12.3) from the whole excavation. Recent excavations at a habitation site in the upland area of Bryniau Bugeilyd south of Llanfairfechan did produce a Graig Lwyd knife flaked from a narrow core in a late Neolithic/EBA context, but small utilitarian artefacts made on flakes were noticeably absent from the site (Smith, personal information).

At other sites, the picture can be more complicated, nowhere more so than at Bryn yr Hen Bobl (Hemp 1935), which lies five kilometres west of Parc Bryn Cegin on the opposite bank of the Menai Strait. Characterised by a large funerary cairn and several associated features (Fig. 8), the site has produced a rich corpus of Graig Lwyd material. However, the artefactual assemblages, however, pose intriguing problems of association, interpretation and chronol-

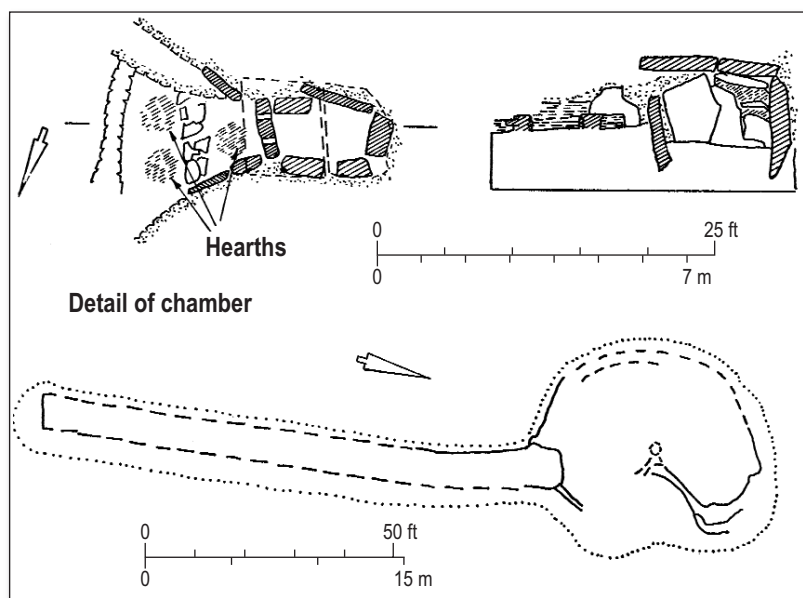


Fig. 8.
Plan and Section of
Bryn yr Hen Bobl,
Anglesey.

ogy (Gresham 1985; Leivers *et al.* 2001), relating particularly to the spatial and stratified relationships of the objects lying beneath, within and outside the enigmatic 'terrace' feature extending to the west of the burial cairn. Incorporated in this assemblage are sherds of early Neolithic pottery, Peterborough ware, two complete and two half fragments of axes made from a local Anglesey dolerite (Burrow 2003; Lynch 1991: Fig. 29, 1–3) and a large corpus of Graig Lwyd debitage. The analysis of this material requires careful consideration because of its uncertain stratified context, but several different elements can be identified (Williams & Kenney 2010). The largest part of the collection, numbering 81 specimens, consists of primary detachment flakes belonging to an evident fabrication sequence. Also included is a Graig Lwyd rough out (Hemp 1935: Fig. 7, 12). A contrasting strand is represented by seven Graig Lwyd flakes with polished surfaces (Fig. 9), only one of which bears similarity to the Parc Bryn Cegin examples. The flake in question is the largest of the polished type, rectangular in shape, measuring 65mm in length by 35mm in width (Fig. 9: 37.7.9) and displaying an uninterrupted polished surface. It obviously represents a first detachment from a large polished object but differs in detail from the ovoid flakes at Parc Bryn Cegin. The remaining six specimens are markedly different in type. The flakes are thick detachments, roughly ovoid in shape displaying small islands of surface polish interspersed between smoothed flake scars with gentle outlines (Fig. 9: 37.7.8, 11, 13, 14, 17, 18). Two of the pieces are unique (Fig. 9: 37.7.17, 18) since they have been retouched to form serviceable, if rather crude, scrapers, the only two diagnostic

examples of flaked artefacts utilizing Graig Lwyd rock apart from axes and large core tools. The other four examples may represent unfinished artefact blanks, but it is apparent that all six specimens have been flaked from the same parent mass which, originally, may have been a lightly, part polished, weathered object. It is therefore concluded that the motive for fragmenting the above series was rather different from what is observed at Parc Bryn Cegin,

Such material indicates that axe fabrication was certainly conducted on site, and that it was certainly possible to fashion other tools from augite granophyre. However, there is also evidence more in line with that from Parc Bryn Cegin; flakes which have clearly been struck from ground and/or polished stone tools such as axes, where an intention or demonstration of use is absent. The complexity of the site and the inadequacies of current phasing make it difficult to take the material from Bryn yr Hen Bobl very far. However, there is enough to demonstrate that here too, it was sometimes appropriate to take old blades apart.

This practice appears to have persisted for some considerable period at Parc Bryn Cegin. The presence of a broken and deformed axe in Pit 1619 suggests that such attitudes were probably in place by the earlier fourth millennium, and contemporary with or slightly later than the occupation of the timber structure. Material from the Grooved Ware associated Pit Group VIII reflects similar concerns. However, these contexts yielded dates between 2900–2670 cal BC and 2880–2580 cal BC, suggesting that even in the later Neolithic, it still mattered to treat certain blades with a measure of respect.

It seems then, that in addition to their evident practicality, there was something about axe blades, and even the stone from which they were made, which sometimes required particular forms of attention. The general absence of a varied inventory of Graig Lwyd flake tools and other artefacts on many sites suggests the operation of subtle protocols which determined the range of uses to which the stone could be put. Such protocols could be observed in the breach, and may not have remained constant over time. But they do seem to have existed, reflected in the relative absence of utilised pieces and in the preferential use made of what was often poor quality flint from coastal Irish Sea Ice deposits. To consistently utilize such a poor, varied and widely scattered raw material at the expense of the more readily available and accessible source at the Graig Lwyd makes little sense if all that mattered was the provision of serviceable tools. And then there are the axes

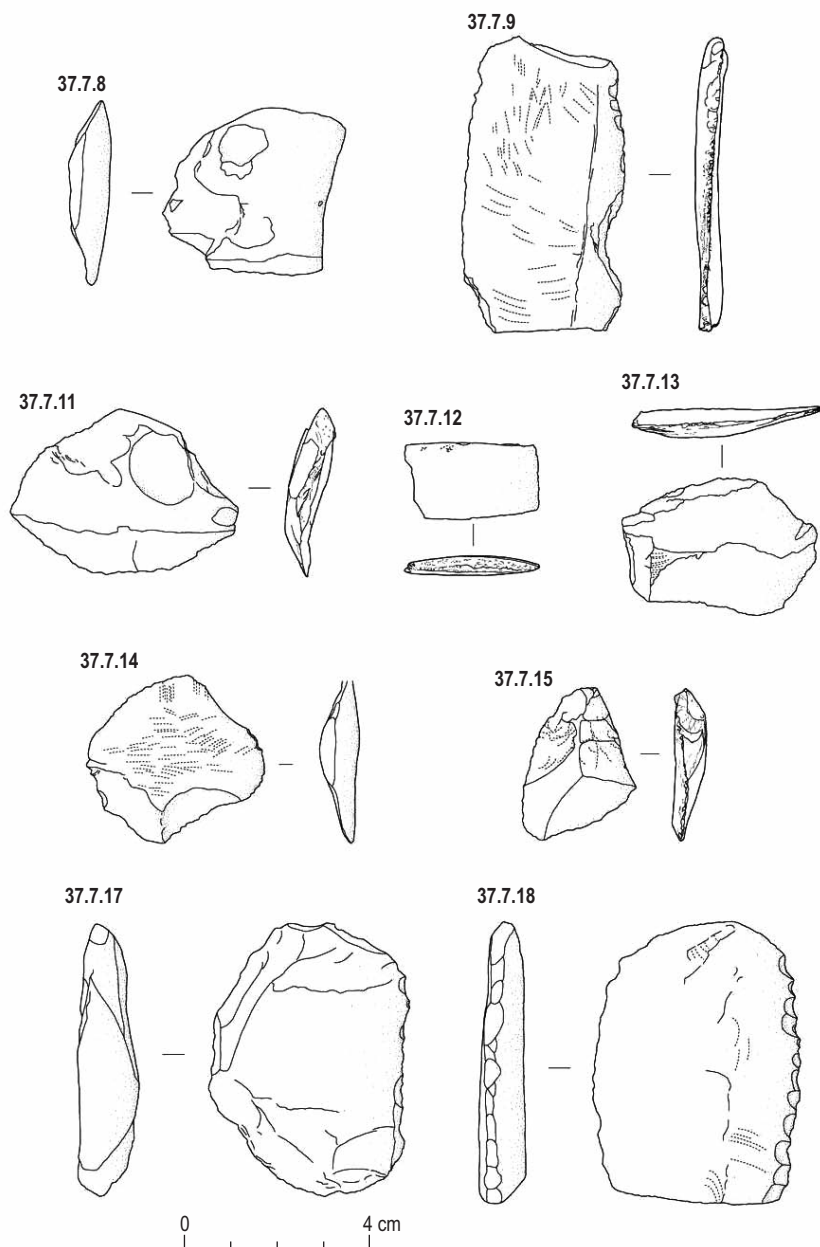
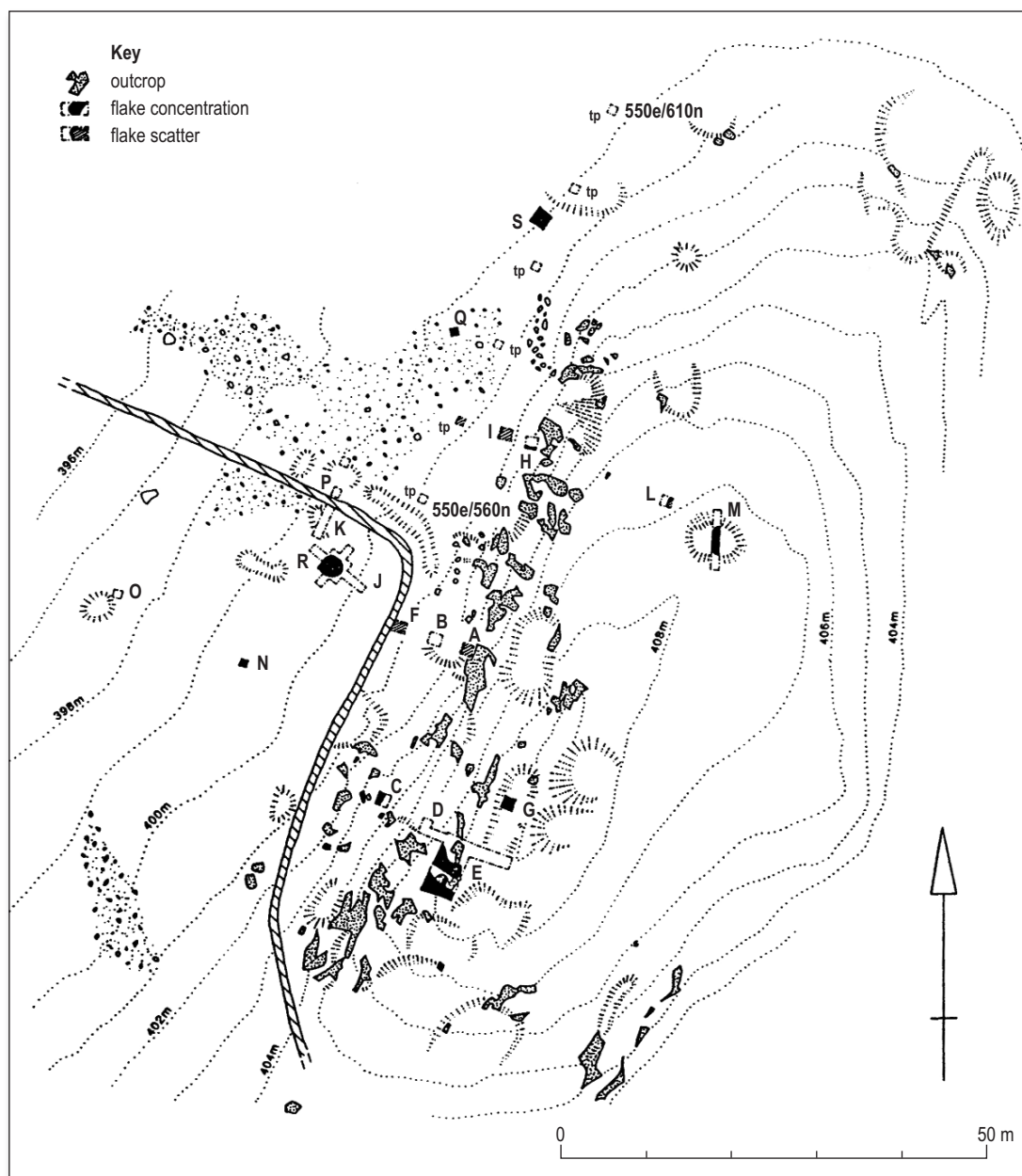


Fig. 9.
Examples of polished
Graig Lwyd pieces from
Bryn yr Hen Bobl.

themselves. Individual flakes removed from ground and/or polished stone axes are a commonplace on many archaeological sites, their presence reflecting the chance breakage or limited damaging of a blade during use (eg. Buckley *et al.* 2001; Edmonds *et al.* 1999; Evans *et al.* 2006; Gardiner 1984). We can assume that this was a common occurrence in many settings where blades were used and that breakage sometimes led to further modification; to reset a cutting edge or adapt a broken axe blade for rehafting. While such activities may be responsible for at least some of the material from Parc Bryn Cegin, the character of many pieces suggests something rather more deliberate.

Evidence from sites across the country lends support to the idea that it often mattered to put blades 'beyond use'. Sometimes, this was a

Fig. 10.
Graig Lwyd,
location of trial
excavations and test pits
at procurement site F.



matter of deposition; in rivers and in other settings where recovery was not an option (Bradley 1990; Edmonds 2004). In other cases, blades could be laid to rest with some formality. One of the best examples is the deposition of a fully flaked roughout placed to stand vertically at the back of the procurement pit in the rock outcrop at site F, trench E (Fig. 10) on the summit of the Graig Lwyd ridge at Penmaenmawr (Williams & Davidson 1999:13). The practice of placing axes within the boundaries of ceremonial enclosures was also evident throughout the period. At Llandygai, Henge A, for example, pit FA 536 produced a Group VI axe in mint condition that had been placed standing vertically, blade downward (Lynch & Musson 2001:46, Fig. 21), a form of positioning also identified in the entrance to the henge at Mayburgh in

Cumbria. A second pit in Henge A (FA 370) containing a cremation, two sherds of pottery in the Peterborough tradition and a flake of crystal tuff, also included a large axe polisher, of uncertain petrographic provenance, placed beside the cremation (*ibid.*:45–6, Figs.18–20). Similarly in Henge B pit, FB39, a triangular slab of sandstone, interpreted as a possible axe polisher, had been placed as a cover stone to seal the deposits below.

Sometimes, it seems that deposition itself was not enough; that proceedings required more immediate forms of treatment. At the Causewayed Enclosure of Etton, several Group VI axes were deposited with some formality, some intentionally smashed before being placed in pits (Pryor 1990). This concern with fragmentation can be found across the country

and in a variety of different settings. Indeed, it is a phenomenon that can be traced across the continent as a whole and throughout much of later Prehistory (Chapman 2000). The deposition of fragmented axes is particularly well attested, a form of treatment accorded from the earliest Neolithic onwards, but one which in Britain reaches its zenith in the latter half of the period (Thomas 1999). Here we find particularly close associations with deposits containing Grooved Ware (Cleal 1984; Edmonds 1995; Roe 1999). For example, Fiona Roe has recorded 28 instances in England, as far north as Yorkshire, in which axes are associated with a variety of organic materials and artefacts of a *specialised* type. Sixteen of the examples noted by her are in pit deposits and invariably the axes are in a fragmentary condition. Examples from well defined petrographic groups are represented and five are associated with Graig Lwyd axes. The recently reported pit at Rothley, Leicestershire (Cooper & Hunt 2005) may now be added to the list. This site featured a large pit complex containing a rich assemblage of Grooved ware in association with a sandstone plaque with a stylised face, flint debitage, 25 flint scrapers in mint condition and the remnant cores of two Charnwood Forest axes (Group XX) with their polished surfaces systematically removed by flaking. A smaller pit contained a single Grooved Ware sherd, a large sandstone rubber, a golf ball sized ceramic ball, animal bone and calcined flint debitage, amongst which was a flint axe fractured by extreme heat to the point of almost total disintegration. To this can be added examples like the heat fractured blade from Sizergh in Cumbria, which was buried in a natural mound beneath an inverted polissoir (Edmonds & Evans 2007), or the numerous pits associated with axe fragments that are a feature of many Later Neolithic sites on the margins of the Fens of eastern England (Cleal 1984; Pollard 2001; Thomas 1999).

Why were so many axes treated in these ways? What made it important that they be smashed or stripped of their polished surfaces, and deposited in a selective and considered manner? Many have suggested that the destruction of objects, particularly those identified in some way as valuables, was a potent and signal act (eg. Bradley 1984, 1990). The destruction of wealth could confer status on those in a position to make such extravagant gestures. Renown might even be gained where deposition in contexts such as rivers or bogs involved the establishment of gift relations with spirits or other supernatural forces. This might

even extend to the dead themselves, where grave goods were gifts given to the deceased during public funerary rituals.

Perhaps inevitably, such arguments tend to be prominent in discussions of *Prestige Goods Economies*, and in models which emphasise competition for position in *Big Man Systems* and *Chiefdoms* (e.g. Thorpe & Richards 1984). They are also commonly invoked where the artefacts involved are found at great distances from their source, the implication being that distance was somehow equated in a systematic manner with value. Such models have their attractions, but they probably do no more than scratch the surface. For a start, the evidence from Parc Bryn Cegin, like that from elsewhere, demonstrates that stone axe blades could be accorded special treatment when their source was close at hand and even still in sight. There is also the sheer volume and variety of blades being produced and circulated, both in local and more extensive networks of exchange. Under these circumstances, it may be better to acknowledge that the reasons why many axes were put beyond use were far more varied than we generally suppose. The associations of an axe, its biography and its link to specific people, came into focus at the side of a pit or when the hammer came down. But what that act meant would have been dependant entirely upon context and audience, on who was involved (Edmonds 1998). The end of a relationship; the completion of a task; rituals designed to neutralise the power of an artefact or bring its life to a close may have even been an important part of individual *rites of passage*. Where the biography of a blade was intimately connected to a person, changes in their status and their relations, even their passage from life to death, might have found expression in the transformation of objects. How far these or other concerns prompted the exfoliation of axe blades at Parc Bryn Cegin is impossible to say. What is clear is that in working to remove the skin from the body of old blades, those who lived there were working in step with much wider traditions.

Conclusion

This paper began by describing the assemblages of worked *Graig Lwyd* stone recovered during excavations at Parc Bryn Cegin, and by highlighting the important sequence of dates derived from associated features. These demonstrate with a reasonable degree of confidence that the (Group VII) outcrop of augite granophyre located around Pen Penmaen was vis-



ited for the extraction of stone and the making of axe blades for much of the Neolithic. Indeed, the very early nature of some of these dates makes it clear that the practice of drawing axes from special outcrops was a primary feature. This should not, perhaps, surprise us. The flow of materials and people around the Irish Sea Zone from the later fifth millennium onwards, created the conditions in which the ideas bound up in the use of these sources could be encountered and taken on board (Bradley 2007; Cooney this volume). From then on, *Y Graiglwyd* was prominent in the region, the source used well into the third millennium and probably still an important landmark when people began to extract copper from the nearby Great Orme. Details in the character and treatment of the material recovered from the site also hint at the kinds of values that people ascribed to axes and even to the parent stone over time. Here, at a relatively short distance from the source, these materials mattered sufficiently that they sometimes had to be dealt with in particular ways. What we hope we have shown is that the processes of *exfoliation* seen at Parc Bryn Cegin are a local expression of a much wider phenomenon of fragmentation and deposition which can be traced across Britain and indeed, across much of the continent.

Inevitably, there are many questions still to be addressed. Within the region, the arguments offered here will undoubtedly benefit from the closer scrutiny provided by the excavation of further well dated assemblages. This is something that even Hazzeldine Warren might have said in the early decades of the twentieth century. However, as the work at Parc Bryn Cegin itself demonstrates, the growth of commercial archaeology makes the realisation of new assemblages all the more likely. We would also argue that it may be wise to look again at raw materials, both through the application of use wear analyses, and in broader studies of patterns of choice in the use of different stones. Future work at the source should also be anticipated, particularly on the buried landscape surrounding Cairn 67, to further elucidate the character of early activity. No doubt such work will throw sharp light on some of the assertions made here. It will also, inevitably, raise new questions.

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Appendix:

Full references for relevant radiocarbon dates from Parc Bryn Cegin

(All single entity samples weighing 1g or less)

Early Neolithic building and pit

KIA-30432

Context: 1486: upper fill of E gable end posthole
1483. Possibly deposited after the post was removed
Material: Charred hazelnut shell
Radiocarbon age: 4903 ± 42 BP
Calibrated date: 3780–3630 cal BC
Posterior Density Estimate: 3740–3640 cal BC

KIA-30433

Context: 1522: fill of postpipe in one of the central postholes, 1532
Material: Charred hazelnut shell
Radiocarbon age: 4899 ± 29 BP
Calibrated date: 3710–3640 cal BC
Posterior Density Estimate: 3710–3640 cal BC

KIA-30434

Context: 1522: fill of postpipe in one of the central postholes, 1532
Material: Charred emmer wheat grain
Radiocarbon age: 4924 ± 30 BP
Calibrated date: 3780–3640 cal BC
Posterior Density Estimate: 3740–3640 cal BC

KIA-30435

Context: 1571: secondary fill of posthole on S wall, 1572
Material: Charred hazelnut shell
Radiocarbon age: 4958 ± 30 BP
Calibrated date: 3800–3650 cal BC
Posterior Density Estimate: 3760–3650 cal BC



KIA-30436a

Context: 1614: fill of postpipe in posthole on S wall, 1613

Material: Oak charcoal (alkali residue)

Radiocarbon age: 5071 ± 29 BP

Weighted mean: 5060 ± 22 BP (T' = 0.3; T' (5%) = 3.8; v = 1; Ward & Wilson 1978)

Calibrated date: 3955–3785 cal BC

Posterior Density Estimate: 3950–3795 cal BC

KIA-30436b

Context: 1614: fill of postpipe in posthole on S wall, 1613

Material: Oak charcoal (humic acids)

Radiocarbon age: 5045 ± 35 BP

Combined with KIA-30436a to give weighted mean given above from which calibrated date is calculated

KIA-30437

Context: 1709: material deposited into top of W end gable posthole after post removed, 1691

Material: Oak charcoal

Radiocarbon age: 4908 ± 30 BP

Calibrated date: 3760–3640 cal BC

Posterior Density Estimate: 3720–3640 cal BC

KIA-31080

Context: 1290: fill of small internal posthole 1291

Material: Charred hazelnut shell

Radiocarbon age: 4832 ± 32 BP

Calibrated date: 3660–3530 cal BC

Posterior Density Estimate: 3700–3630 cal BC

KIA-31081

Context: 1340: fill of small internal pit 1339

Material: Charred hazelnut shell

Radiocarbon age: 4952 ± 29 BP

Calibrated date: 3800–3650 cal BC

Posterior Density Estimate: 3760–3650 cal BC

KIA-31082

Context: 1340: fill of small internal pit 1339

Material: Charred hazelnut shell

Radiocarbon age: 4871 ± 30 BP

Calibrated date: 3710–3630 cal BC

Posterior Density Estimate: 3710–3640 cal BC

KIA-31083

Context: 1369: upper fill of small internal posthole 1370

Material: Charred hazelnut shell

Radiocarbon age: 4993 ± 29 BP

Calibrated date: 3940–3700 cal BC

Posterior Density Estimate: 3770–3660 cal BC

KIA-31084

Context: 1389: post-packing deposit in one of the central postholes 1406

Material: Charred hazelnut shell

Radiocarbon age: 4899 ± 29 BP

Calibrated date: 3710–3640 cal BC

Posterior Density Estimate: 3710–3640 cal BC

KIA-31085

Context: 1405: fill of postpipe in one of the central postholes 1406

Material: Charred hazelnut shell

Radiocarbon age: 4989 ± 26 BP

Calibrated date: 3910–3700 cal BC

Posterior Density Estimate: 3770–3660 cal BC

KIA-31086

Context: 1445: charcoal-rich fill in post trench 1404

Material: Charred wheat grain

Radiocarbon age: 4912 ± 29 BP

Calibrated date: 3760–3640 cal BC

Posterior Density Estimate: 3720–3640 cal BC

KIA-31087

Context: 1723: post-packing deposit in W gable end posthole, 1691

Material: Charred cereal grain

Radiocarbon age: 4905 ± 34 BP

Calibrated date: 3780–3630 cal BC

Posterior Density Estimate: 3720–3640 cal BC

KIA-31088

Context: 1631: charcoal-rich fill within large pit, contained broken stone axe, 1619

Material: Charred hazelnut shell

Radiocarbon age: 4630 ± 31 BP

Calibrated date: 3520–3350 cal BC

KIA-31089

Context: 1631: charcoal-rich fill within large pit, contained broken stone axe, 1619

Material: Charred hazelnut shell

Radiocarbon age: 4946 ± 34 BP

Calibrated date: 3800–3650 cal BC

Neolithic pit groups**Pit Group I****NZA-26671**

Context: 1051: fill of small pit with Mortlake Ware, 1052

Material: Charred hazelnut shell

Radiocarbon age: 4504 ± 30 BP

Calibrated date: 3360–3090 cal BC

NZA-26672

Context: 1051: fill of small pit with Mortlake Ware, 1052

Material: Charred hazelnut shell

Radiocarbon age: 4437 ± 30 BP

Calibrated date: 3330–2920 cal BC

Pit Group V**NZA-26679**

Context: 4149: charcoal-rich fill towards base of pit with Fengate Ware, 4133

Material: Residue from pot sherd in SF 569 (vessel V.A)

Radiocarbon age: 4479 ± 30 BP

Calibrated date: 3350–3020 cal BC



Pit Group VI

NZA-26680

Context: 6005: fill of pit with Grooved Ware, 6041

Material: Charred hazelnut shell

Radiocarbon age: 4567 ± 30 BP

Calibrated date: 3490–3120 cal BC

NZA-26681

Context: 6005: fill of pit with Grooved Ware, 6041

Material: Charred hazelnut shell

Radiocarbon age: 3976 ± 30 BP

Calibrated date: 2580–2460 cal BC

NZA-26687

Context: 6066: upper fill of pit with Fengate Ware, 6072

Material: Charred hazelnut shell

Radiocarbon age: 4467 ± 30 BP

Calibrated date: 3340–3020 cal BC

NZA-26688

Context: 6073: lower fill of pit with Fengate Ware, 6072

Material: Charred hazelnut shell

Radiocarbon age: 4517 ± 30 BP

Calibrated date: 3360–3090 cal BC

Pit Group VII

KIA-30440

Context: 3144: upper fill of pit, 3146

Material: Wood charcoal, <10 years, species not identifiable

Radiocarbon age: 4724 ± 44 BP

Calibrated date: 3640–3370 cal BC

KIA-30441

Context: 3154: fill of pit, 3155

Material: Charred hazelnut shell

Radiocarbon age: 3476 ± 28 BP

Calibrated date: 1890–1690 cal BC

KIA-30442

Context: 3154: fill of pit, 3155

Material: Charred hazelnut shell

Radiocarbon age: 3388 ± 29 BP

Calibrated date: 1750–1610 cal BC

NZA-26682

Context: 3137: upper fill of pit, 3139

Material: Charred barley grain

Radiocarbon age: 3474 ± 30 BP

Calibrated date: 1890–1690 cal BC

NZA-26689

Context: 3145: lower fill of pit with Early Neolithic pot, 3146

Material: Hazelnut charcoal

Radiocarbon age: 4797 ± 30 BP

Calibrated date: 3650–3520 cal BC

NZA-26690

Context: 3137: upper fill of pit, 3139

Material: Charred hazelnut shell

Radiocarbon age: 3552 ± 30 BP

Calibrated date: 1980–1770 cal BC

Pit Group VIII

NZA-26691

Context: 1308: primary fill of pit, 1309

Material: Charred hazelnut shell

Radiocarbon age: 4178 ± 30 BP

Calibrated date: 2890–2630 cal BC

NZA-26692

Context: 1308: primary fill of pit, 1309

Material: Charred hazelnut shell

Radiocarbon age: 4139 ± 30 BP

Calibrated date: 2880–2580 cal BC

NZA-26693

Context: 1554: main fill of pit with Grooved Ware, 1553

Material: Charred hazelnut shell

Radiocarbon age: 4201 ± 30 BP

Calibrated date: 2900–2670 cal BC

NZA-26694

Context: 1554: main fill of pit with Grooved Ware, 1553

Material: Charred hazelnut shell

Radiocarbon age: 4192 ± 30 BP

Calibrated date: 2890–2670 cal BC



■ ■ ■ A *Mere* or hand weapon from New Zealand, currently residing in the Yorkshire Museum. Made from *Pounamu*, the Maori term for sacred (*Tapu*) greenstones such as Nephrite Jade and Bowenite, which outcrop on the South Island (also known as *Te Wāhi Pounamu* – the place of Pounamu).

The *Mere* was, and remains, an artefact of high renown, possessing *Mana*, a spiritual quality fundamental to the authority or respect vested in particular places, people and institutions. Associated with warfare but also with many myths of origin, the *Mere* was an inalienable symbol of status, possession one of the expressions and requirements of chieftanship. Many blades had names and were handed down, important as talismans that ensured the reproduction of authority and the continued vitality of the wider community across the generations. The *whakapapa* or genealogy of individual blades would be recalled during important ceremonies, even featuring in songs that spoke of great events in the past and of connections to important ancestors. The *Mana* associated with individual blades also gave them a potency in specific kinds of exchange, most notably the forging of peace agreements and new alliances.

During the nineteenth and early 20th centuries, the *Mere* took on a new significance in the West, circulating as a prized collectible and as an object of academic discourse. Many arrived as the trophies of retiring colonial officers, before being given to museums where they found a new significance as parallels for prehistory. Many can still be found in institutional storerooms across Europe, names long forgotten, lying side by side with Neolithic stone blades. ■

●●● *There's this field, not far from the east coast. M
used to go there every summer for his holidays
and each year, he'd walk it. Must have had twenty
or thirty axes or bits of axes off of it. There must
be something going on; with that many in one
place. I wonder what he did with all the stuff he
found. ●*



Neolithic polished stone axes and hafting systems:

Technical use and social function at the Neolithic lakeside settlements of Chalain and Clairvaux

Abstract

This paper describes hafting systems for polished stone axes and adzes from middle and late Neolithic contexts in Eastern France, dated between the 4th and the beginning of the 3rd millennium BC.

In this area, indirect hafting systems using antler sleeves are particularly frequent. An axe sleeve is an intermediate piece which is fixed between the wooden haft and the polished stone blade.

Indirect hafting systems present an advantage for the hafting of very short blades. The present study is based on the exceptional assemblages from sites in the French Jura, in particular the lakeside settlements of Chalain and Clairvaux where axe and adze sleeves are extremely numerous. More than 800 have been recorded and analysed.

Here, typological trends and technical aspects, including manufacturing processes, use and maintenance of antler sleeves are discussed and related to their archaeological and environmental contexts.

Introduction

This paper focuses on evidence for the hafting systems employed on polished stone axes and adzes from lakeside settlements in the French Jura. More precisely, it deals with indirect hafting systems that involved the use of an intermediate piece or sleeve, inserted in the wooden haft to hold the blade. The use of sleeves presents several advantages. First, they allow the hafting of short implements, produced from stone blade fragments. Second, they act as an important shock absorber, preserving the wooden hafts by preventing them from splitting during use (Winiger 1981; Jeudy *et al.* 1997; Maigrot 2003b; Croutsch 2005).

The present study is based on the remarkable remains recovered from sites in the French Jura, notably the lakeside settlements of Chalain and Clairvaux (Pétrequin & Pétrequin 1988; Pétrequin *dir.* 1989 & 1997). Due to anaerobic conditions, these lake-dwellings have preserved an exceptional archaeological record, including a large number of organic artefacts. In addition, dendrochronology allows us to follow with great precision (by ten-year steps) the evolution of material culture, including the hafting systems. Polished stone axes and adzes played a major role in the equipment of these Neolithic communities established in a woodland environment. On these sites, antler sleeves are extremely high in number. For the present study, more than 800 have been recorded, measured and analysed (Maigrot 2003b, *in prep.*).

The paper begins with a description of the typological development of sleeves and hafting systems from middle and late Neolithic contexts in Eastern France, dated between the 4th and the beginning of the 3rd millennia BC. This sets the scene for a detailed discussion of the character and contexts of manufacturing processes, sleeve usage and maintenance, and for the interpretation of those processes in economic and social terms.

Typology and chronology

The present study is based on assemblages from six lakeside settlements (Fig. 1): two of them dated to the Middle Neolithic (Clairvaux XIV and Clairvaux VII) and three to the Final Neolithic (Chalain 2C, Chalain 4 and Chalain 19). The two Middle Neolithic sites are assigned to the Néolithique Moyen Bourguignon (hereafter abbreviated NMB and dated to the first half of the 4th millennium BC). With the excep-

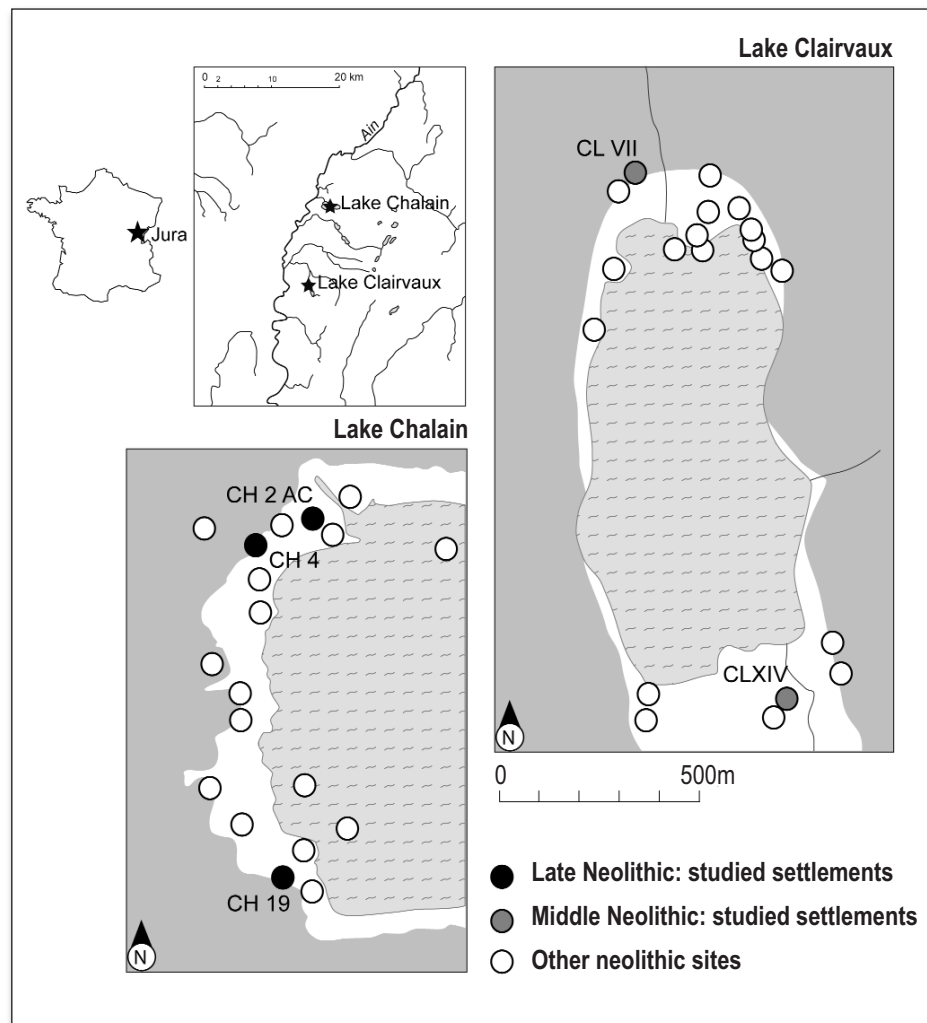


Fig. 1.
Location of the
sites in this study.
Excavations: P. Pétrequin.

tion of layer O at Chalain 19, attributed to the Horgen group (about 3200 BC), the Final Neolithic series belong to the Clairvaux group (beginning of the 3rd millennium). These sites have been selected due to the quantity of recorded artefacts in order to base the study on a representative sample.

These six sites yielded 2266 tools made from bone, antler or tooth, of which 827 are sleeves, representing more than one third of the total bone equipment (Fig. 2). This illustrates the importance of such pieces, and of bone processing, in the Neolithic of the French Jura. Such artefacts are also very abundant in Switzerland. To give an example, more than 1200 sleeves have been recorded from Montilier/Platzbünden alone, located on the shore of Lake Morat in the Canton of Fribourg (Ramseyer 1999). Based on these Swiss assemblages, different typological systems have been established (Schwab 1971; Suter 1981, 1987; Voruz 1984, 1991, 1997; Winiger 1985). Some of these typological systems are exceedingly detailed and complex. For example, the classification established by H. Schwab (1971) com-



Fig. 2.

Bone and antler tools from the sites of Chalain and Clairvaux: quantitative data. This table only includes the tools; the 2264 technical pieces (roughouts and fabrication waste) are excluded.

			Nb bone and antler	Nb antler sleeves	% antler sleeves
Late Neolithic	Groupe de Clairvaux	CH 2C	413	223	54%
		CH 19 HK	603	255	42%
		CH 4	794	212	27%
	Horgen	CH 19 O	90	25	28%
Middle Neolithic	NMB	CLXIV	139	32	23%
		CLVII	227	80	35%

prises as many as sixty-eight subtypes. Here, we follow a simpler path, using the exemplary typology constructed by A. Billamboz, who differentiates sleeves according to the hafting type with which they are associated (Billamboz 1977; Billamboz & Schlichtherle 1982, 1999). This allows us to make sufficient useful distinctions between: mortise sleeves, perforating sleeves, tenon sleeves and sleeves with transverse perforation (Fig. 3).

Socketed sleeves (Fig. 4)

Socketed sleeves are the earliest sleeve type to occur in Switzerland. The first instances have been recorded in the Canton of Lucerne during the 43rd century BC (Egolzwil 3, between 4282 and 4275 BC; Wyss 1994). In France, socketed sleeves appear later, during the second part of the NMB culture, in the upper levels of settlements VII and XIV at Clairvaux, about 3600 BC (Pétrequin 2005). Prior to this date, other sleeve types are already in use, in particular sleeves with simple tenon or spur sleeves. Thereafter, socketed sleeves occur in assemblages in rather stable proportions of 10–20 %, until the Final Neolithic (Fig. 3).

Socketed sleeves are provided with a mortise on either end: one holding the stone blade, the other inserted in the tenon of the wooden haft (Fig. 4). They systematically equip adzes with

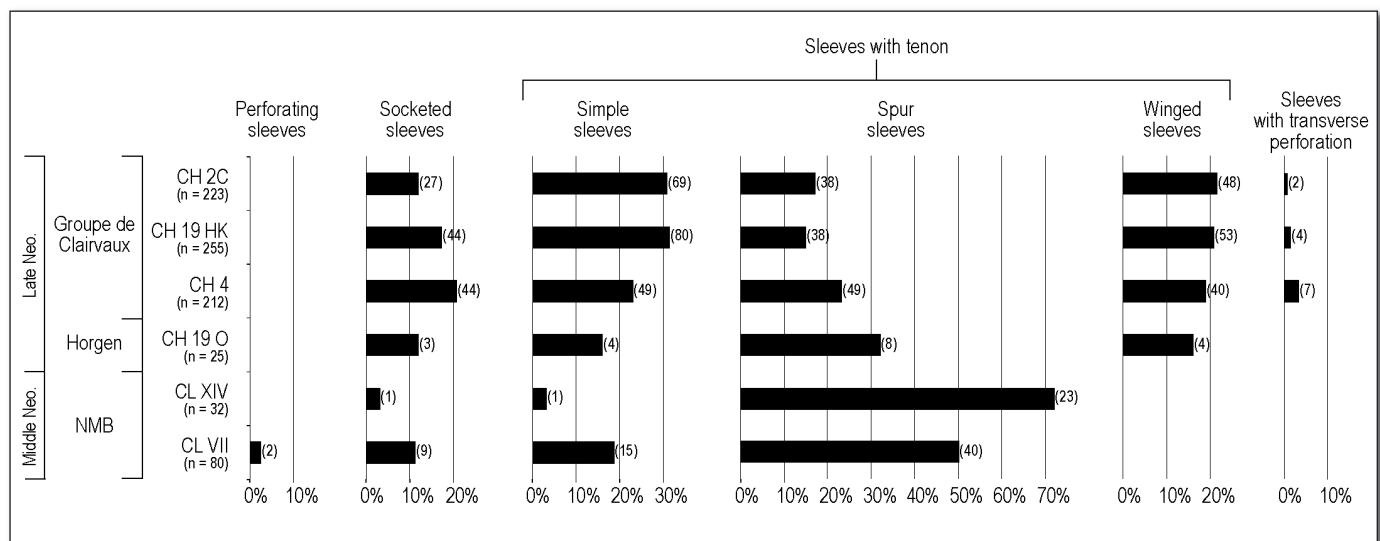
the polished stone blade placed perpendicular to the long axis of the haft (Figs. 4.8 & 9). According to archaeological finds from Chalain and Clairvaux, the bent handles are made from a branched fork of oak, beech or maple (Baudais 1985, 1987; Baudais & Delattre 1997).

Socketed sleeves were manufactured from a basal or central antler segment, more rarely from a beam segment (Fig. 4.10). They are the smallest type of sleeves with an average length of 8 cm. The distal mortise (holding the blade) always has an oval-shaped section. Moreover, the morphology and volume of mortises shows that they were intended to hold small, sometimes very short blades with a rather flat section. The proximal mortise (hafting) presents a rather circular section during the Middle Neolithic while mortises with oval-shaped sections prevail during the Final Neolithic.

Perforating sleeves (Fig. 5)

In Switzerland, the Middle Neolithic, and more particularly the Cortaillod and Pfyn cultures, are characterized by perforating sleeves (Billamboz 1982; Suter 1981; Gross *et al.* 1987; Schibler *et al.* 1997; Wey 2001). In the French Jura, this type is rare. In fact, only two examples have been recorded, both from NMB levels at Clairvaux VII, and none are found after the end of the Middle Neolithic. These sleeves are elon-

Fig. 3.
Antler sleeve distribution by type.



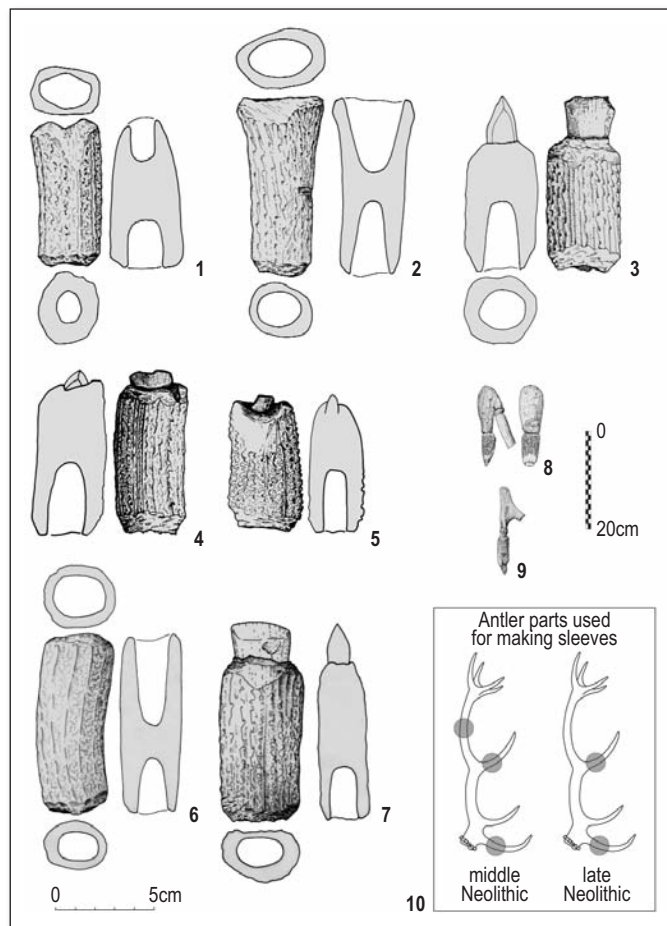


Fig. 4.

Socketed sleeves.

1 to 3:

Clairvaux VII
(Middle Neolithic);

4 and 5:

Chalain 4
(Final Neolithic);

6:

Chalain 19 HK
(Final Neolithic);

7:

Chalain 2
(Final Neolithic);

8 & 9:

Hafted socketed sleeve,
Chalain 4
(Final Neolithic);

10:

Location of the
antler parts used for
the manufacture of
socketed sleeves.

Drawings 1 to 9:

A.-M. Pétrequin

gated, with lengths between 16 and 17 cm. They are made from a rather straight antler segment, in general a crown tine (Fig. 5.4) and are adapted to straight, slightly curved handles (Fig 5.3 Bontemps *et al.*, *in prep.*). They go through the massive head of the handle, with the antler extremity coming out at the back. Towards the basal part of the antler (cutting zone) a mortise is hollowed out to hold the polished stone blade. This mortise has an oval-shaped section and is rather flat. In these cases too, associated blades are quite flat-sectioned.

Tenon sleeves (Figs. 6, 7 & 8)

This type is composed of a tenon and a crown. The mortise in which the stone blade is inserted is hollowed out in the crown. The transition between the tenon and the crown is generally marked by a shoulder, which can be slight or very distinct.

As tenon sleeves are intended for axes, the polished stone blade is placed parallel to the long axis of the haft (Figs. 6.8, 7.7 & 8.5). They equip handles with blind mortises, with slightly curved heads for the Middle Neolithic and with swelled heads for the Final Neolithic. These handles are generally made from ash or beech and their dimensions are fairly variable, from 50–70 cm. Tenon sleeves make up the majority discovered at Chalain and Clairvaux, for both the Middle and the Final Neolithic.

Three subtypes of tenon sleeves are commonly distinguished: simple sleeves, spur sleeves and winged sleeves.

Simple sleeves (Fig. 6)

Simple sleeves occur from the Middle Neolithic period onwards and persist until the Final Neolithic in ever increasing proportions (Fig. 3). They are made from a lower or upper beam segment. The type and the part of

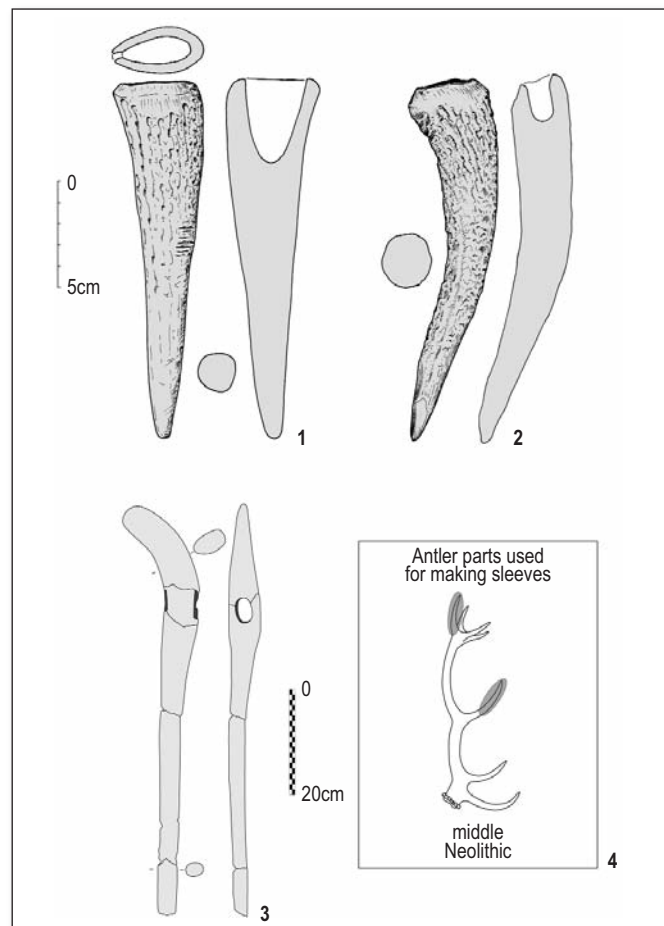


Fig. 5.

Perforating sleeves.

1 & 2:

Clairvaux VII
(Middle Neolithic);

3:

Curved handle associated
with perforating sleeves,

Clairvaux VII
(Middle Neolithic);

4:

Location of the antler
parts used for the
manufacture of
perforating sleeves.

Drawings

1 & 2: A.-M. Pétrequin;
3: according to Bontemps
et al. en preparation



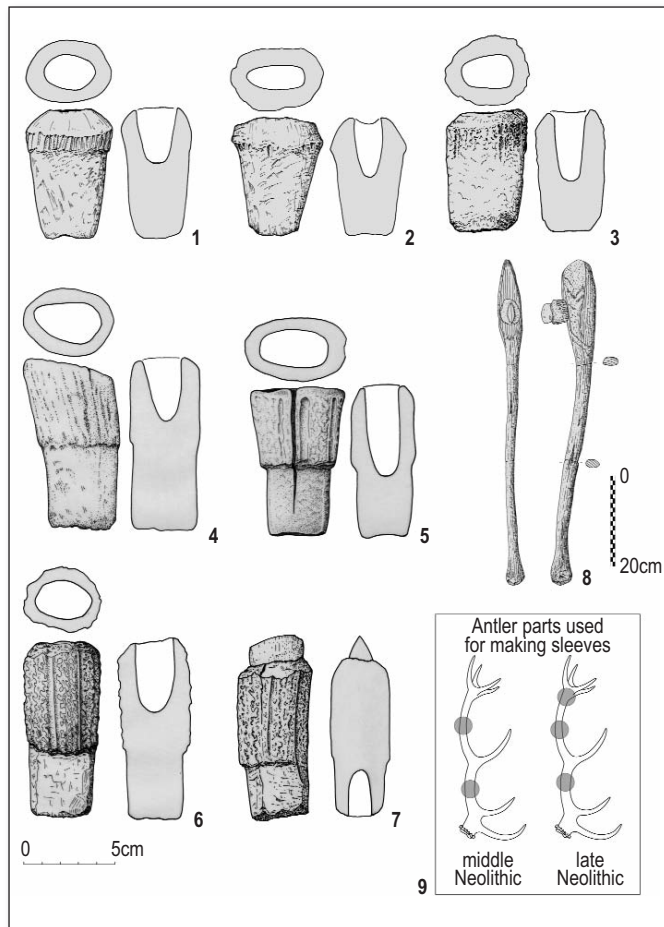


Fig. 6.
Simple sleeves.
1 & 2:
Clairvaux VII
(Middle Neolithic);
3:
Clairvaux XIV
(Middle Neolithic);
4 & 5:
Chalain 19 HK
(Final Neolithic);
6 & 7:
Chalain 2
(Final Neolithic);
8:
Hafted simple sleeve,
Chalain 4
(Final Neolithic);
9:
Location of the antler
parts used for the
manufacture of
simple sleeves.

Drawings 1 to 8:
A.-M. Pétrequin

the antler selected for the blank fabrication of these sleeves has a direct influence on the shape of the crown (Fig. 6.9). Thus we distinguish:

- * sleeves with a wide crown, cut-off immediately below the basis of the palm (Fig. 6.5);
- * sleeves with a cylindrical crown cut-off from a lower or upper beam shaft which, in addition, can be straight or oblique depending on the cutting angle of the beam segment (Figs. 6.6 & 4).

During the Middle Neolithic, the crowns are systematically straight and particularly short. From the beginning of the Final Neolithic (Horgen), however, crowns become distinctly longer and their morphology more varied (wide, straight, oblique, etc.). Likewise, the tenon shapes evolve. The tenons of simple sleeves from the Middle Neolithic show a rather circular section and converging edges (Figs. 6.1, 6.2 & 6.3), while the ones from the Final Neolithic have a rather rectangular section and parallel edges (Figs. 6.4, 6.5, 6.6 & 6.7). As for the shoulder, slightly marked at the beginning of the period, this tends to become increasingly marked and deep at the end of the Neolithic. The measurement of mortise volume shows that simple sleeves held much more massive blades than socketed sleeves. The blades were generally oval in section.

Spur sleeves (Fig. 7)

Spur sleeves are characterized by a crown showing a "...more or less pronounced protuberance which is not blocked against the wooden handle..." (Billamboz 1977:114). In the Middle Neolithic, this is the most frequent type of sleeve, accounting for between 50 % and 70 % of the total. From the Horgen phase onwards, the production of spur sleeves significantly

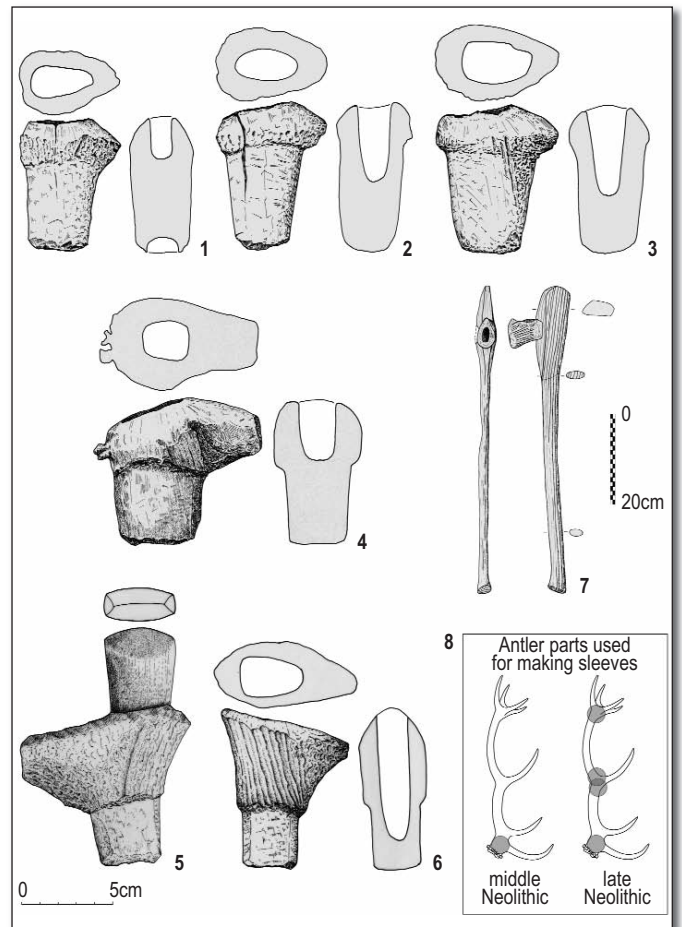


Fig. 7.
Spur sleeves.
1 & 2:
Clairvaux VII
(Middle Neolithic);
3:
Clairvaux XIV
(Middle Neolithic);
4:
Chalain 19 O
(Final Neolithic);
5:
Chalain 19 HK
(Final Neolithic);
6:
Chalain 2
(Final Neolithic);
7:
Hafted spur sleeve,
Chalain 4
(Final Neolithic);
8:
Location of the antler
parts used for the
manufacture of
spur sleeves.
Drawings 1 to 6: A.-M.
Pétrequin; 7: N. Delattre



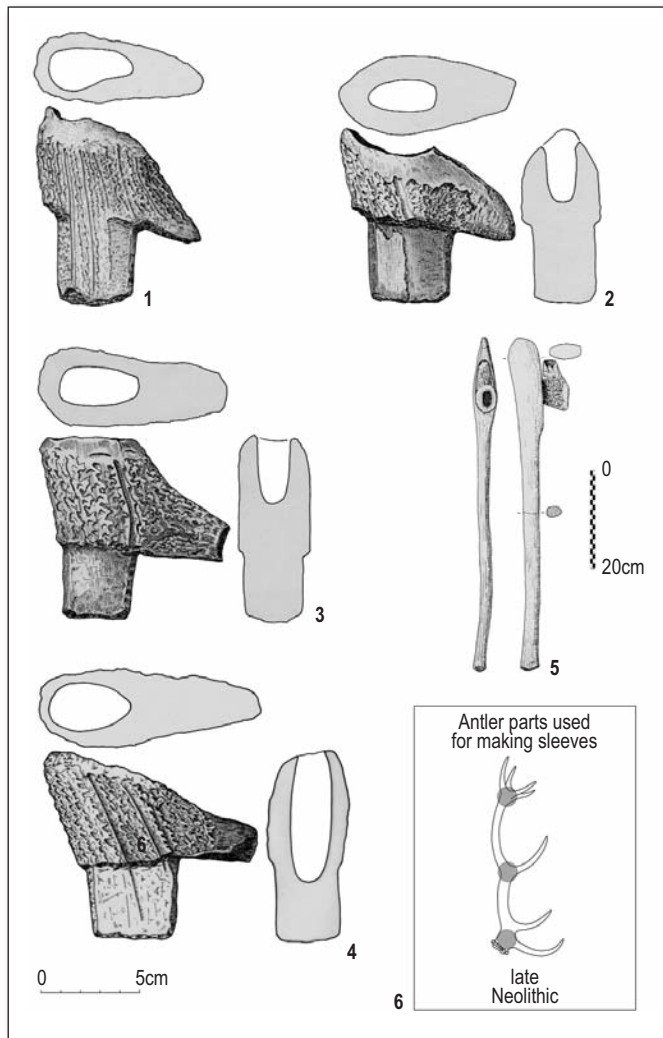


Fig. 8.

Winged sleeves.

1:

Chalain 4

(Final Neolithic);

2 & 3:

Chalain 19 HK

(Final Neolithic);

4:

Chalain 2

(Final Neolithic);

5:

Hafted winged sleeve,

Chalain 19 HK

(Final Neolithic);

6:

Location of the antler

parts used for the

manufacture of

winged sleeves.

Drawings 1 to 5:

A.-M. Pétrequin

decreases in favour of more basic shapes. Spur sleeves were made from a fork on the antler (Fig. 7.8). During the Middle Neolithic and until the beginning of the Final Neolithic, one can observe the deliberate use of basic junctions (antler burr or junction between lower beam and basilar antler). From the 30th century BC, central and upper bifurcations (junction beam and central antler or basis of the palm) are increasingly used for the manufacturing of this sleeve type.

During the Middle Neolithic, the crown, more often straight than oblique, is always shorter than the tenon (Figs. 7.1, 7.2 & 7.3). The opposite is observed for the Final Neolithic sleeves (Figs. 7.4, 7.5 & 7.6). Moreover, a clear lengthening of the spur can be observed. The development of tenons and the shoulders is comparable to that of simple sleeves. The blades associated with spur sleeves are rather massive and have an oval section.

Winged sleeves (Fig. 8)

Winged sleeves are defined as pieces presenting "...a flat rather long surface extending from the shoulder which blocks against the wooden haft..." (Billamboz 1977:114). These sleeves do not occur in NMB contexts. They appear only in the Final Neolithic, where their frequency steadily increases (Fig. 3). Most are made from a fork situated between the beam and the central antler. Basilar antler parts are also used, but more occasionally and mostly during the Horgen (Fig. 8.6). The length of the wing gradually becomes longer through time and stabilized at 3–4 cm by the

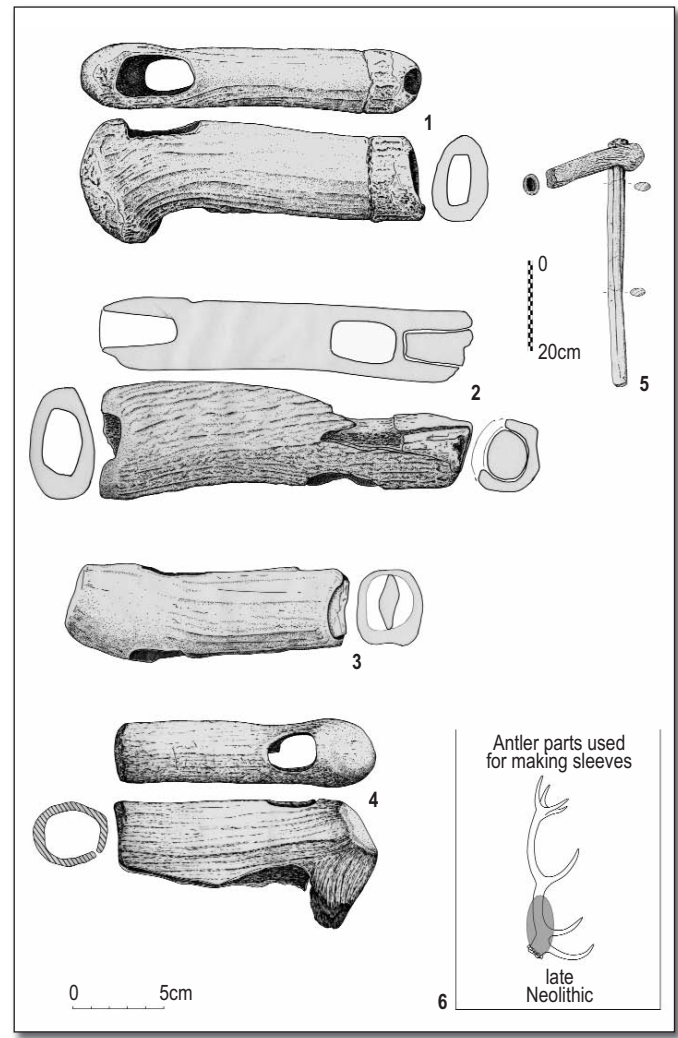


Fig. 9.

Sleeve with
transverse perforation.

1:

Chalain 4

(Final Neolithic);

2 & 3:

Chalain 19 HK

(Final Neolithic);

4:

Chalain 2

(Final Neolithic);

5:

Hafted sleeve with

transverse perforation,

Chalain 4

(Final Neolithic);

6:

Location of the antler

parts used for the

manufacture of sleeves

with transverse

perforation.

Drawings 1 to 4: A.-M.

Pétrequin; 5: N. Delattre



end of the Clairvaux group; for comparison, in the Horgen layer at Auvernier Gravier (Switzerland, Canton of Neuchâtel), the length of the wing is 2–4 cm (Ramseyer 1982).

Generally, the measurements on sleeves from the French Jura show a trend towards morphometric standardization. As with the simple tenon or spur sleeves, the crown of the sleeve can be straighter (Fig. 8.3) or more oblique (Figs. 8.1 & 4), depending on how the blank was cut. At the end of the Clairvaux group, increasingly deep mortises extend past the crown in one third of the examples; as for the tenon, the latter is frequently square-cut and the shoulder deeply marked. Like the spur sleeves, winged sleeves held massive stone blades.

Sleeves with transverse perforation (Fig. 9)

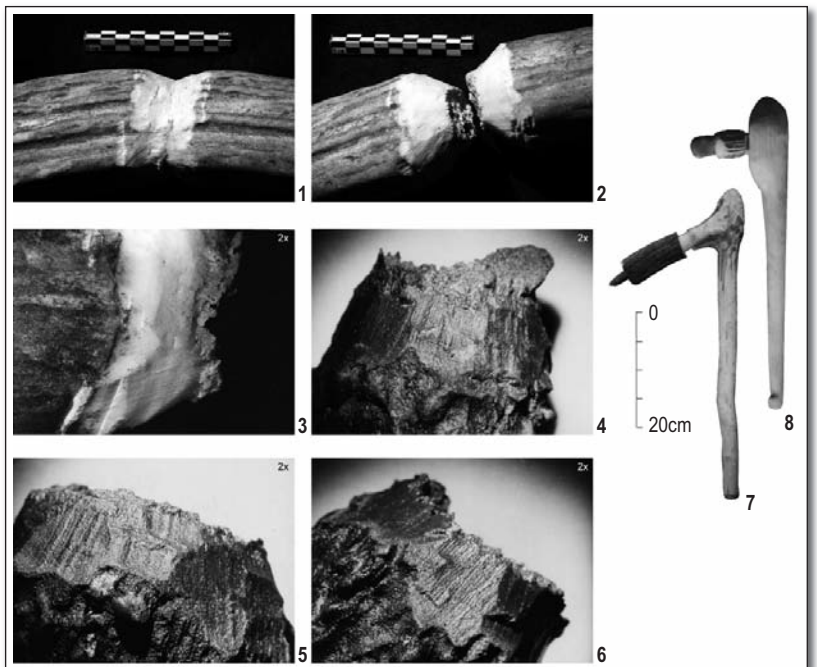
These sleeves are fixed in a transverse manner to a straight handle with a tenon, generally made from ash (Fig. 9.5). The hafting angle measured from completely preserved pieces is almost 90°. These sleeves, specific to the Final Neolithic, are rare and represent less than 5% of the total number (Fig. 3). This sleeve type does not occur in Switzerland before the Lüscherz, during the 29th century BC (Voruz 1984 & 1997; Winiger 1985), while it is present in the French Jura as early as the 31st century BC. It probably originates from Northern France, in particular from Seine-Oise-Marne contexts where large numbers are known, notably from burials (Bailloud 1979; Burnez-Lanotte 1987).

These massive pieces can measure up to 20 cm in length. They are made from a lower beam segment or from a basilar part of antler without its tines (Fig. 9.6). In the latter case, two shaping types are possible:

- * the mortise, for the polished stone is shaped at the beam end and the burr forms the proximal part (Figs. 9.1, 9.3 & 9.4);
- * the mortise is hollowed out at the burr end (*médaille*) and the beam end forms the proximal part, the base of which can be reinforced by antler plugs (Fig. 9.2).

The transverse perforation intended for hafting has an oval section and is located in the first third of the piece starting from the proximal end. It should be stressed that this sleeve type could equip both, adzes and axes. When the blade is lacking, the orientation of the mortise to the haft enables the two tool types to be distinguished. The stone blades associated with these sleeves are generally massive.

Fig. 10.
1 & 2:
Experimental debitage
by Notching;
3:
Details of the
experimental removals;
4 to 6:
Details of the
removals observed on
archaeological pieces,
Chalain 4;
7:
Experimental adze;
8:
Experimental axe.



Taken together, the patterns described above provide the basis for a number of general observations. To begin, perforating sleeves only occur in the Middle Neolithic period and occur in smaller numbers in the French Jura than in contemporary Swiss assemblages. Socketed sleeves do not appear before the second half of the Middle Neolithic and continue until the Final Neolithic with quite stable shapes and frequencies. Simple tenon sleeves and spur sleeves occur in both the Middle and the Final Neolithic. However, the shapes show a distinct chronological trend, tenons have a truncated cone in the Middle Neolithic and become square in the Final Neolithic. There is also a clear tendency towards the lengthening of the sleeves, mainly involving crown, the length of which doubles. Winged sleeves and sleeves with transverse perforation are the characteristic types of the Final Neolithic. Lastly, sleeves with bifid tenons, though frequent in the Swiss Final Neolithic from the Lüscherz onwards (Winiger 1985; Voruz 1984, 1991), are absent from the assemblages in the French Jura.

Manufacturing processes

In order to interpret technical traces on archaeological sleeves, a variety of different experiments have been conducted (Maigrot 2001 & 2003b). Set alongside data from roughout and manufacturing waste analysis, these experiments allow a reconstruction of operational sequences for the production of antler tools and more particularly of antler sleeves.

In the French Jura, antler was worked by notching as early as the Middle Neolithic. Though notching has been recognized and described by antler tool specialists from an early stage, experiments on this technique are sparse (Provenzano 2001). Our experiments have clarified how the objects were made, as well as identifying traces related to this process. Notching consists of cutting into the antler cortex with a sharp and resilient tool. When carried out with a polished stone blade on fresh antler, this technique leaves diagnostic traces characterised by striations in the removal negatives, the dimension and orientation of the latter depending on percussion angle (Fig. 10).

More generally, operational sequences related to sleeve manufacturing seem to be highly standardized. The identification of the operational steps involved in the manufacture of tenon sleeves clearly illustrates the rigour of their sequence. This operational sequence is established in the Middle Neolithic and remains unchanged until the Final Neolithic. The first stage is to cut out the blank by notching. The cortex is chopped away by percussion with an axe or an adze on its whole circumference in order to create a groove sufficiently deep to allow a separation by breakage. Then, still by notching, but this time practised by low angle retouch, the crown is shaped: the upper edges are adjusted and the wing or spur is shaped if necessary. In the same manner, the tenon is sculpted. Finally, the mortise which holds the polished stone blade is hollowed out in the spongy tissue, in general by scraping with a bone bevel or a flint flake. This is done in a last stage to guarantee the best fit between the sleeve and the stone blade.

Despite the chronological development of sleeve morphology observed between the Middle and the Final Neolithic, the manufacturing processes themselves remain fairly stable. From a technical viewpoint, the only aspect that changes is raw material management, more precisely the pattern of selection from the antler rack. While most of the sleeves in the Middle Neolithic are made from basal sections of antler, during the Final Neolithic the central and upper sections are the most frequently used. Indeed, from the Horgen on, burr and lower beam are intended for the manufacturing of a new tool, the production of which steadily increased until the end of the period: a massive bevelled artefact, also called a "hammer axe". In parallel, use of the central and upper parts increases by a factor of three the number of sleeves produced from a single antler rack (Figs. 7.8 & 8.6).

Usage

From use-wear...

In a second series of experiments, we have used several axes and adzes equipped with sleeves in order to establish a repository of traces relating to the use of these hafting elements (Maigrot 2003b). These experimental reproductions have been used for different purposes such as working wood or bone and antler. As the sleeve is an intermediate piece and not an active piece, it cannot exhibit traces characteristic of the worked materials. However, these experiments have identified specific use-wear, such as hafting traces or traces of maintenance of polished stone blades.

Based on the study of about fifteen experimental sleeves, the use-wear patterns on the mortise as well as on the tenon and the crown have been described (Fig. 11). Thus, after use, the internal surfaces of the mortise become smooth and regular owing to compression of the spongy tissue through contact with a tightly inserted stone blade. Likewise, repeated insertion and removal of the sleeves from the wooden haft, rubs out the technical traces related to shaping of the tenon (or the mortise), leaving a polished and striated surface (Fig.

Fig. 11.

- 1:
Experimental winged sleeve;
- 2 to 4:
Experimental simple sleeves (the black arrow indicates a longitudinal crack);
- 5:
Detail of use-wear on a tenon, observed on an experimental sleeve.

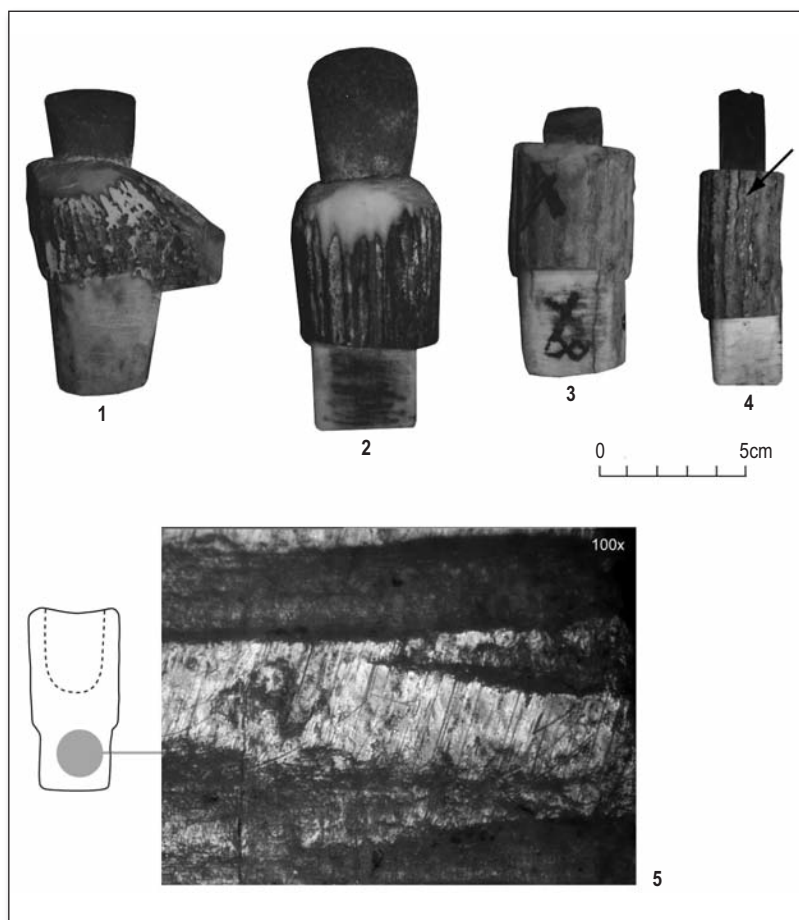
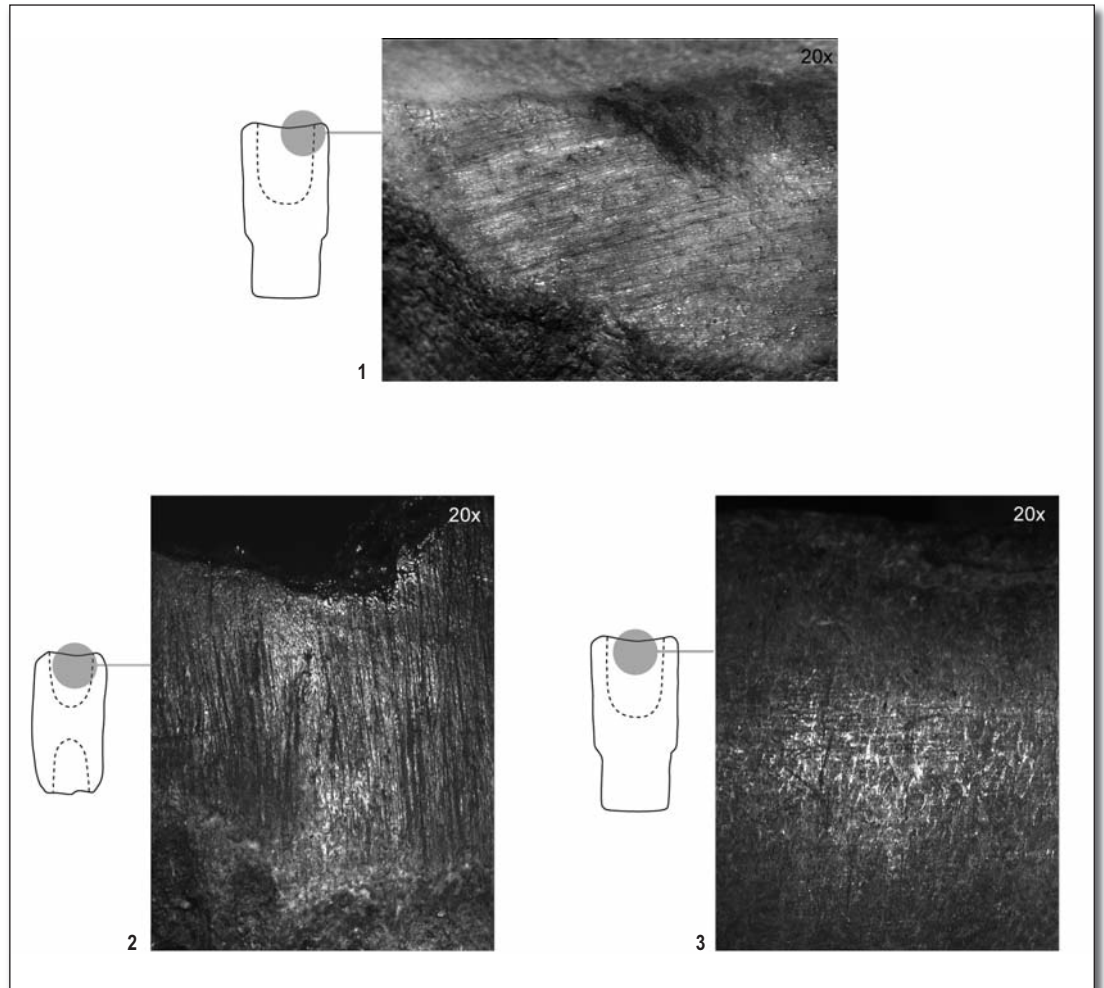


Fig. 12.

- 1:
Abrasion zone observed
on the crown of an
experimental sleeve;
2:
Abrasion zone observed
on a socketed sleeve,
Chalain 4
(Final Neolithic);
3:
Abrasion zone observed
on a tenon sleeve,
Chalain 4
(Final Neolithic).



11.5). These different traces can also be found on the archaeological specimens.

Though rarely referred to, sharpening is a major action on which the good functioning of the tools depends. Sharpening and use form a recurrent cycle which generates considerable morphological change in a tool. During the experiments conducted with reproductions of axes or adzes we have observed that it was very difficult to remove a worn stone blade. During re-sharpening we have always kept the blades in their sleeves as this ensured a better grip. However, sharpening by abrasion of the cutting edge of the stone blades marks the rim of the sleeve's crown (Fig. 12.1). This alteration, characterised by a very distinct abrasion zone indirectly testifying to the sharpening of the blades, has often been observed on archaeological sleeves and constitutes reliable evidence for usage. The examination of these zones shows some variety in the abrasion striations and, more broadly, the sharpening techniques. Thus, the orientation of the striations indicates the sharpening direction (parallel or perpendicular to the cutting edge). Their width, depth and pattern indicate the type of polisher used (fine-

grained or coarse-grained, cemented or not, etc.). The analysis of experimental tools and of completely preserved archaeological specimens (sleeve + blade) seems to indicate that the extension of these abrasion zones depends on the length of the blade and on the abrasion angle. The smaller and more flat-sectioned the blades are, the more their sharpening risks damaging the crown of the sleeve.

Socketed sleeves from Chalain and Clairvaux, which were fitted on bent handles, exhibit important, often covering abrasion zones, on either side of which deep and slightly crossed striations are invariably orientated perpendicular to the cutting edge of the inserted blade (Fig. 12.2). These wear patterns indicate sharpening of short blades on a coarse-grained medium cemented polisher. On the tenon sleeves associated with straight handles, these zones are shorter and often result from an action conducted parallel to the cutting edge of the stone blades (Fig. 12.3). Thus, tenon sleeves apparently held longer stone blades than socketed sleeves, as is indeed shown by completely preserved archaeological pieces. Moreover, the striations observed on the crown of the tenon

sleeves are generally finer than those recorded on the socketed sleeves. The abrading stone used for the re-sharpening of the cutting edge of the blades inserted in these sleeves would thus be rather fine-grained. These different techniques of maintenance show, in an indirect manner of course, the functional diversity of the axes and adzes for both the Middle and the Final Neolithic.

Consolidation and repair serve to prolong the existence of implements. While consolidation actions prevent possible fracture points, repair takes place after breakage. These practices provide direct evidence for tool management and should thus be considered as well. Our experiments have shown that in the course of use, stone blades are progressively driven into the mortise hollowed out in the spongy antler tissue. Exposed to constant pressure, the crown of the sleeves tends to crack longitudinally or to shatter (Figs. 11.3 & 11.4). Examples with cracks are extremely frequent in the archaeological record (Figs. 6.4 & 6.5; Figs. 7.1 & 7.2). An incision placed transversally across the crack distributes the lateral forces on either side, thus preventing complete rupture of the sleeve (Figs. 13.1 & 13.2). "Crack stops" (arrêts de fissure), frequently observed on archaeological material, are known from the Middle Neolithic onwards (Billamboz 1977).

Neolithic people developed different solutions to prevent the blade butt being gradually driven into the mortise. The first consists of placing a flexible and solid intermediate piece between the butt and the mortise, absorbing shocks during use and thus avoiding compression of the spongy tissue. Different materials have been used to achieve this effect. Thus, we have extracted compressed fragments of a fungus belonging to the *Polyporaceae* family from the mortise of four sleeves (one at Chalain 4 and three at Chalain 19). These polyporales are characterised by a ligneous, extremely tough structure; consequently, they are perfectly adapted to this type of usage. Other sleeves show the utilisation of bark, wrapped around the butt of the axe blade (Fig. 13.3). In that way, not only the spongy tissue is protected but also the blade fits perfectly into the mortise. A second solution is the insertion of a small rod of antler cortex in order to consolidate the crown and to wedge the blade firmly. Other types of repair are known. For example, on a sleeve with transverse perforation a groove was made to hold a binding for the crown which was cracked (Fig. 13.4). All these practices mainly occur during the Final Neolithic.

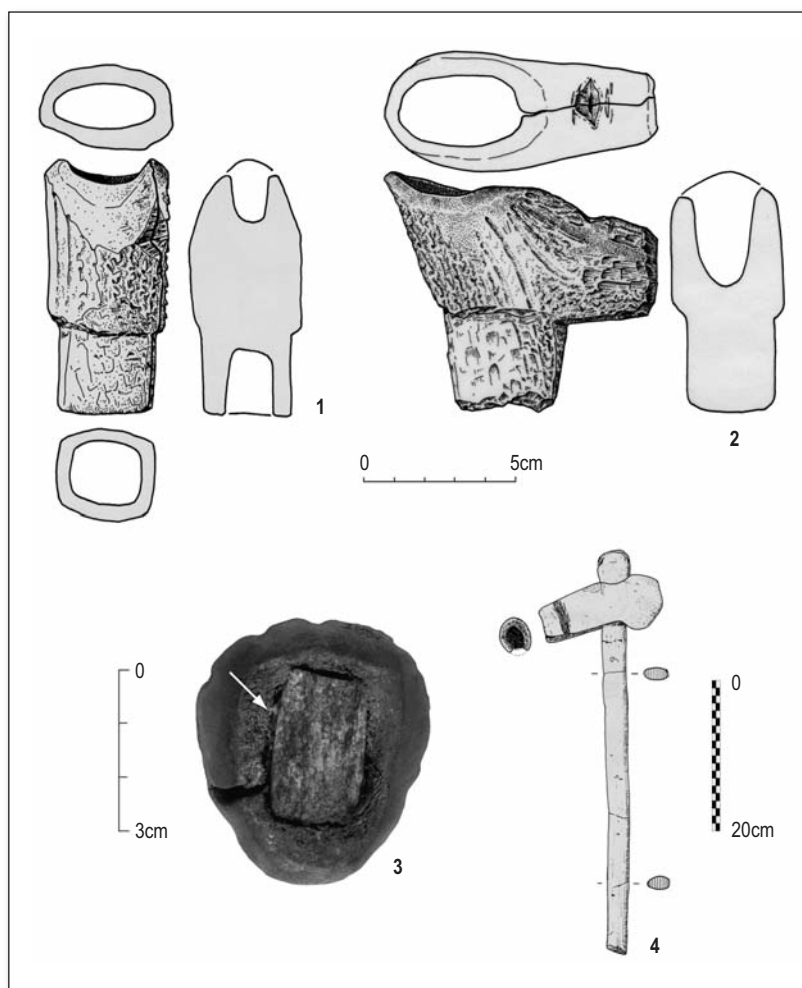


Fig. 13.

1 & 2:

Tenon sleeves with
« crack stop »,
Chalain 19 HK
(Final Neolithic);

3:

Sleeve consolidated with
a piece of bark indicated
by the white arrow,
early Chalain-Clairvaux
ancient excavations
(Final Neolithic);

4:

Repaired sleeve with
transverse perforation.

Drawings 1 & 2:

A.-M. Pétrequin;

4: N. Delattre;

Photo 3: P. Pétrequin

... to the function of axes and adzes

In order to improve our understanding of Neolithic axes and adzes, we must consider other types of evidence. The ethnographic cases recorded in New Guinea by A.-M. and P. Pétrequin (2000) show that axes and adzes equipped with polished stone blades are polyvalent tools. They are used for numerous tasks such as the felling of trees, the cutting of poles, the splitting of planks, carving wooden objects, and also debarking, shaping bone knives and butchering animals etc. From the purely technical viewpoint, axes and adzes are not restricted to wood cutting but serve multiple needs, both domestic and communal. The question here is whether we can see any equivalent variety in our archaeological evidence.

As we have seen, the Neolithic examples do seem to indicate quite a varied tool range. This variation, which is linked to the size and the weight of the whole implement, as well as to the hafting angle, shape and size of the blade itself, suggest a certain diversity of function. None of the use wear traces observed on the sleeves permit direct identification of wood-working. However, supported by an experimen-



Fig. 14.

Timber showing traces of a blow from a polished stone axe, Chalain 3 (Final Neolithic).

Photo: P. Pétrequin
(Choulot *et al.* 1997, 188)



tal basis of comparison, the technical traces recorded from archaeological remains discovered *in situ*, directly indicate usage of axes and adzes (Fig. 14; Choulot *et al.* 1997). Following on from the observations made in New Guinea, it is likely that the larger axes and adzes were probably used for the felling of trees (to provide timber and/or to clear land), and also for the preparation and trimming of constructional timber (notching and pointing of posts, splitting of planks, etc.). The shortest axes and the adzes, as they are light and manageable, seem better adapted for work in secondary forests, in the management of woodlands and in other, lighter, carpentry tasks. Single-handed tools with a narrow cutting edge could also have been used for the precise and more delicate shaping of roughouts of numerous wooden artefacts (bows, bowls, handles, etc.) (Maigrot 2004).

The technological analysis of the antler tools also shows that axes and adzes played a crucial part in the production of this equipment (Fig. 10). As we have seen, they not only ensure the whole debitage process of the antler racks, but also contribute to the main shaping stages of the antler tools. It is highly probable that axes and adzes were used for a number and variety of other activities (butchering, skin work, etc.). However, only a multidisciplinary approach incorporating both technical and functional analyses of stone blades, sleeves and handles, will enable the nature of these activities to be determined.

The picture will only ever be partial. But there is already enough to indicate the ubiquity of axes and adzes in the performance of many tasks. For the farmers of Chalain and Clairvaux, living in a more or less dense forest environment, axes and adzes were indispensable tools. Although used in a variety of ways, this equipment served first and foremost for the clearing of the forest, for the opening of fields and for the preparation of timber intended for the construction of houses and village buildings. We

are thus dealing with activities which took place outside the household area, involving several people, as well as activities directly related to the natural environment and to territorial appropriation (Maigrot 2005).

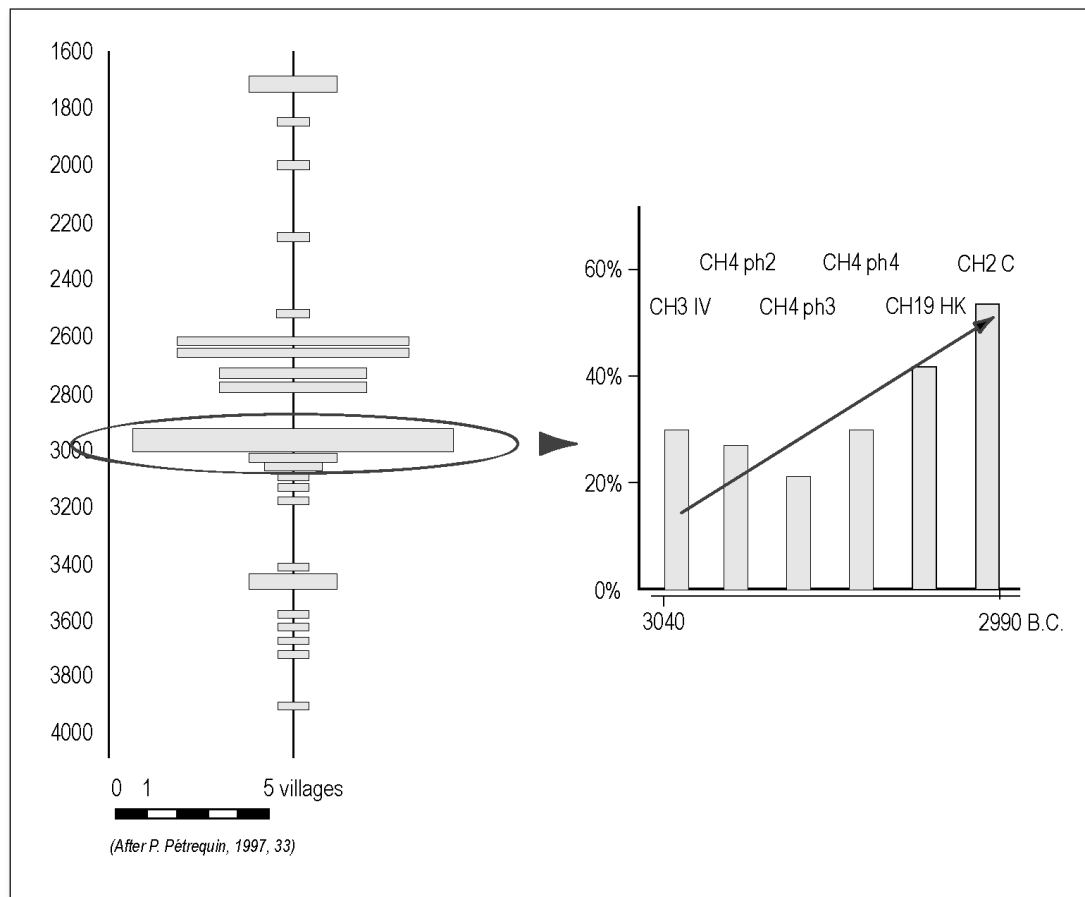
From the technical to the social

The patterns described above gain further significance when set in broader contexts. Dendrochronological dates associated with detailed palaeoenvironmental sequences provide a very precise time-frame for following changes in both the environment and the pre-historic communities on the shores of Lake Chalain and Lake Clairvaux. The histories of these lakesides show a strong correlation between phases of improved climate and increases in the number of observable settlements (Pétrequin *et al.* 1998 & 2003; Pétrequin 1999 & 2005). The most spectacular increase is seen on the shores of Lake Chalain around 3040 BC, with a threefold increase in the number of occupations within less than one generation. In parallel to this demographic boom, palaeoenvironmental evidence shows massive alteration of the vegetation directly related to forest exploitation.

This increase in the scale of human impact on territory had many repercussions, but would have certainly been a source of stress for deer populations who were necessarily sensitive to a human presence. In particular, it is likely that the scale of alteration would have impacted on male animals, leading them to develop antlers of poorer quality (i.e. of small size, with anatomical anomalies). Ironically, these antlers were for the most part destined for the production of equipment used precisely for the exploitation of the environment from which the animals came. It is during this period of 'crisis' that the most significant increase in antler tools and, more particularly in antler sleeves, is recorded (Fig. 15).

Changes in the character and quality of antler forced adaptations which can be recognized in raw material management and also in the morphology and quality of artefacts. Thus the sleeves were no longer produced from the basal part of antler (reserved for the production of massive bevelled tools) but from the central and upper parts, which have a thinner cortex and from which more fragile artefacts are obtained. In addition, the highest numbers of consolidated, repaired or even recycled pieces are found at this time (Maigrot 2003a). This usage results from successive choices which





beyond technical determinism and environmental constraints, primarily depend on the ideological representations that these populations had of their environment and of themselves, especially in their social structure. It is astonishing, however, that no other solutions were found for replacing deer antler with other materials, or for elaborating different hafting systems. The persistence of the use of antler sleeves at all costs seems to emphasise the close link which related this animal to the exploitation of the natural environment in the representation system of these communities.

Fig. 15.
Correlation between
population growth on the
shores of Lake Chalain
and the increase in antler
sleeve production.

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Nigel W Jones

Steve Burrow



A potential axe factory near Hyssington, Powys:

Survey and excavation 2007–08

Abstract

Field investigations were conducted over two seasons in an attempt to locate the production site of the Group XII Bronze Age battle-axes and axe-hammers. In the 1950s a potential source had been identified on a small hill near Hyssington in Powys, where a number of picrite outcrops and small-scale workings had been identified.

Field survey, geophysical survey and excavation investigated an obvious quarry site, as well as several small quarry scoops. Although the quarry proved to be relatively recent in date, the smaller workings remain undated. It still seems likely, however, that this outcrop was the source of the picrite from which the axes were fashioned, although the precise location of the production site remains unidentified.

The unexpected discovery of a number of stone carvings in close proximity to the areas of extraction has given new significance to the site. The decoration is similar to examples found in Neolithic contexts in Scotland and Ireland.

Introduction

The production site of the Group XII Bronze Age battle-axes and axe-hammers has long been a subject of speculation. They are made from a distinctive rock type known as picrite which has a very limited distribution, one of the few known outcrops being a small hill just to the north-west of the village of Hyssington in eastern Powys (SO 305950; Fig. 1).

The Hyssington area was first suggested as a potential source for the axes in a study by Shotton, Chitty and Seaby, published in the *Proceedings of the Prehistoric Society* in 1951. They identified a number of likely rock sources around the unnamed hill, which they referred to as Cwm Mawr. Since the 1950s products from the axe factory have been found over a wide area, while a number of other local features such as picrite outcrops, boulders and

small quarries have been recorded in the vicinity.

A programme of topographical survey, geophysical survey and trial excavation was undertaken during 2007 in an attempt to confirm the source of picrite axes followed by a second season in September–October 2008 which was joint project between the Clwyd-Powys Archaeological Trust with funding from Cadw, and Amgueddfa Cymru – National Museum Wales.

Petrology

Petrological studies have proved invaluable in the study of stone tools, helping to identify specific sources for implements manufactured from a variety of different rock types. Macroscopically picrite is a dark, coarse-grained, rough and

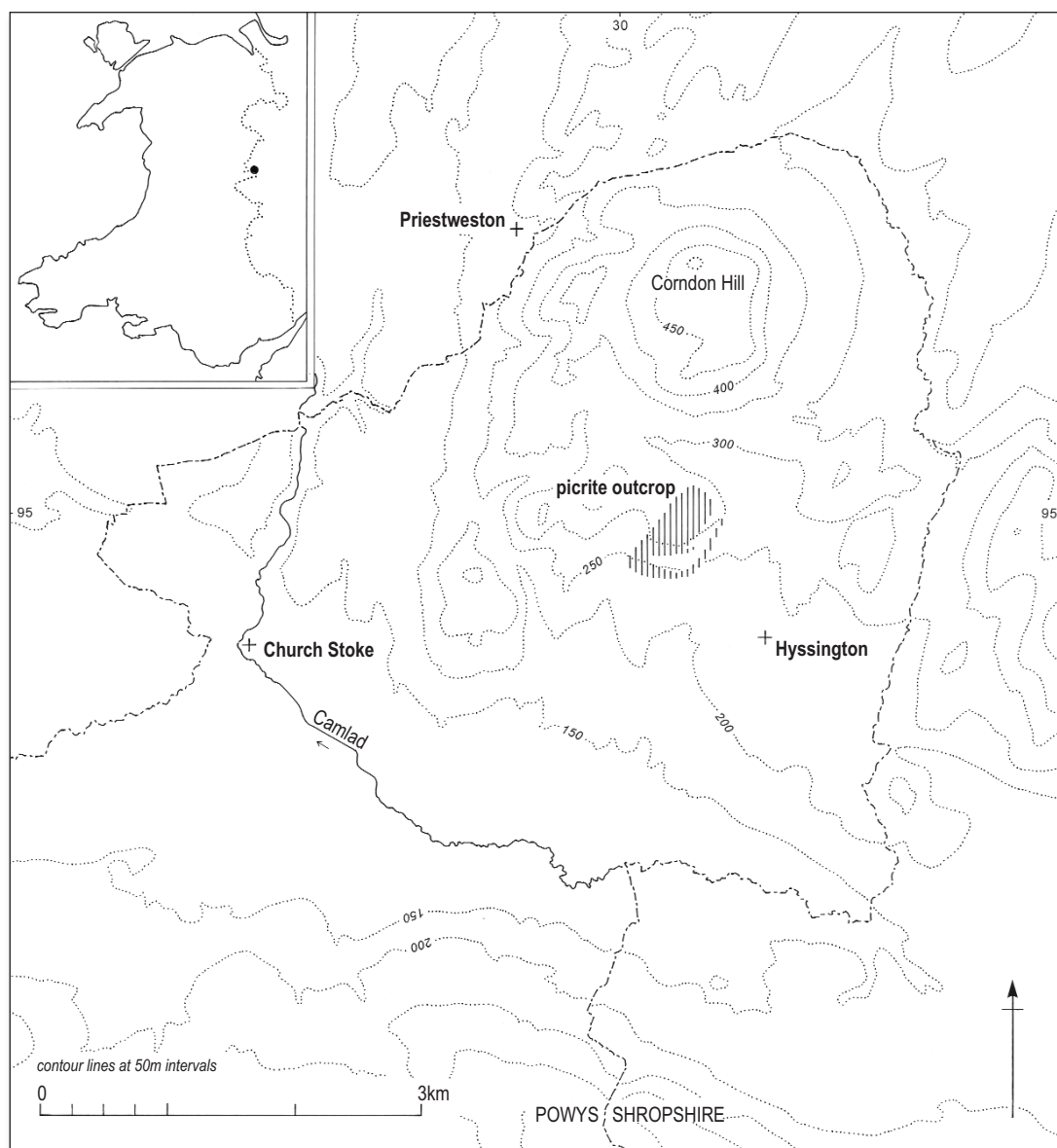


Fig. 1.
Location of the
picrite outcrop.



heavy igneous rock. Microscopically it is a very distinctive ultrabasic rock consisting of fresh olivine, augite plates and subordinate amounts of feldspar with a little brown mica (Stone & Wallis 1951:127). Thin sections of samples collected from Hyssington and taken from a number of picrite axes were compared by Shotton and found to be extremely similar. The picrite is mainly confined to a small hill immediately to the south of Corndon Hill, and although there are other minor sources within the area these are intensely weathered, unlike the material used for axe manufacture (Shotton *et al.* 1951:159–160).

Shotton defined the dominant minerals within picrite as: olivine, in sub-rounded grains up to 1mm in diameter, fresh except for narrow bands of pale yellowish serpentine on the outside and along cracks; plagioclase feldspar, occasionally thermally altered, but usually fresh; and pale, almost colourless augite. The proportion of olivine is always high and may be as much as 80%, although in the thin sections of implements it was between 32% and

50%. Although there are other sources of picrite apart from the one near Hyssington, the products of Group XII have a distinctive feature which closely matches the picrite from that particular outcrop: ‘wherever olivine was in contact with feldspar (and is now separated by a narrow line of serpentine), there have developed reaction rims of bright apple-green chlorite . . . the patches of bright green coloration in ordinary light is a feature which is most arresting’ (Shotton *et al.* 1951:163).

Implement types and manufacture

It has not been feasible to review the typology of all Group XII implements during this research but the Implement Petrology Committee (IPC) of the Council of British Archaeology claims that the products of Group XII are confined to battle-axes and axe-hammers.

While no radiocarbon dates exist for Group XII implements, recent work on sites in Ireland

Fig. 2.
Group XII axe-hammer,
battle-axe and
miniature battle-axe
(Photo: NMW).



and Scotland which contained similar implements, albeit made from other rocks, have produced radiocarbon dates spanning the period 2100–1650 BC (Brindley 2007:371; Sheridan 2007:fig. 14.9). There is no obvious reason why this date range, or a part thereof, cannot also be applied to the currency of Hyssington products.

The earliest known battle-axes in Britain are associated with Beakers and their form appears to have developed over time, the earlier examples having a convex profile with the greatest depth towards the butt end; early Group XII battle-axes in particular are likely to be large and crudely shaped. As the form developed the battle-axes became more concave, ultimately achieving a long, slender profile with comparatively widely expanded ends. Group XII picrite was particularly used for the more evolved forms. axe-hammers are altogether larger and more crudely shaped than battle-axes and can be divided into two main groups, Class I which are basically convex in profile, and Class II which are concave, although it is possible to define sub-groups depending on the position of greatest depth. The majority of known Group XII axe-hammers may be defined as Class II. The chronology of axe-hammers is assumed to be similar to battle-axes, despite a general lack of associated dateable material (see Shotton *et al.* 1951:fig. 1; Roe 1966; Roe 1979).

The manufacture of both axe-hammers and battle-axes involved similar technology, with the latter being characterised by more complex shapes and a finer finish. They were often, but not exclusively, made from coarse-grained rocks, with picrite being well-suited to this purpose. Around Hyssington, picrite can be found in three useful forms of decreasing size: outcrop, boulder, and smaller weathered blocks. The closer the form of the raw material to the size and shape of the intended axe-hammer the less time and effort would need to be expended in manufacture.

For an axe-hammer to be produced from an outcrop or boulder a suitable blank has to be removed. Since excavation failed to find any evidence of fire setting at Hyssington, the only means by which this could be achieved would have been by percussion. Rough flake scars on picrite boulders found in trench 3 prove that outcrops and boulders can be broken up by percussion, but the quarry debris (layer 18) which presumably resulted from this activity was irregular and ill-suited to axe-hammer production. Picrite's coarse fabric makes it unlikely that axe-hammer blanks were broken directly from the outcrop or from large boulders.

Occasional blocks of weathered picrite of the right size and shape for use as axe-hammer blanks were found in the trenches. These had an iron-rich outer crust of decayed rock which could be broken away to reveal fresh material inside. An attempt was made to shape one of these blanks using a hammerstone, but this was abandoned after about two hours when the piece broke along a visible flaw. It seems likely that many weathered blocks would contain internal flaws – but these would have quickly become apparent to anyone working a block on site, allowing them to move on to another for relatively little wasted effort.

Experimental work by Fenton (1984) demonstrated that one way to minimise the risk of using flawed blanks was to choose material derived from river beds. Rocks in this environment have already been tested through turbation, with abrasion reducing them to a cobble shape which corresponds closely to the axe-hammer form. cursory investigation did identify picrite in the stream-beds to the south of Hyssington, but no cobbles were found which were suitable for use as axe-hammer blanks.

On present evidence it thus seems that axe-hammer manufacturers probably did exploit picrite at source, but they would have had more success grubbing out small weathered blocks either from the subsoil or from within fissures in the bedrock, than in tackling large boulders and outcrop material.

Suitable blanks were probably worked by pecking with a hammerstone until the chosen form was achieved, the time involved being dependant on the amount of material that had to be removed from the chosen blank. Fenton's study (1984:223) indicates that this rough shaping could be completed in less than half a day. Removal of the resulting peck marks by grinding against a stone slab need only have taken a few hours. Experimental grinding of picrite confirmed these findings, with the resulting dark grey-green surface being speckled with translucent blotches marking patches of altered olivine. This brings to mind the better known speckled appearance of spotted dolerite – the bluestone of Stonehenge and of Group XIII axe-hammers – and may have been part of the appeal of the picrite.

From an archaeological perspective this technology is unlikely to leave behind substantial traces. Hammerstones and broken rough-outs might be expected, although since none were found in the excavated areas it is likely that working took place on the lower ground below the hill.



Distribution of Group XII products

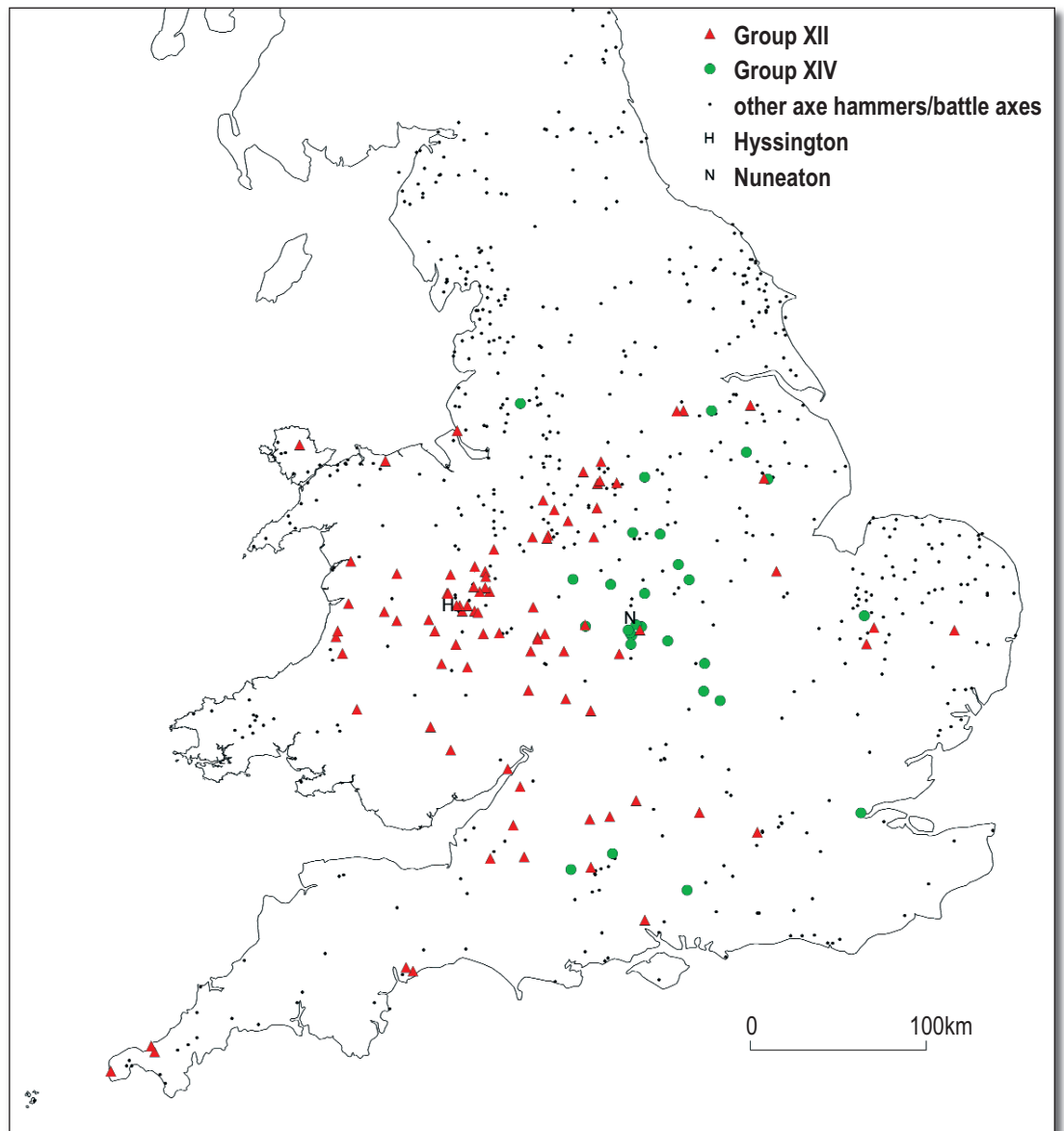
The thin section programme of the IPC has identified ninety-three implements likely to have originated at Hyssington (see Clough & Cummins 1988). These implements are generally found in central Wales and the West Midlands, centring on Hyssington, but with the fringes of the distribution extending into the rest of Wales and southern and eastern England. Outliers include examples from as distant as Fife and Cornwall (see Fig. 3).

The products of Group XII are confined to battle-axes and axe-hammers and viewed alone, the ninety-three Group XII products appear to have been of some importance in the Early Bronze Age of central Britain, but it is worth tempering this view with the evidence from the 700 other axe-hammers which have

been thin-sectioned in England and Wales. If one plots axe-hammer findspots against their distance from Hyssington a number of patterns emerge. Group XII implements dominate the finds within an easy day's walk from the picrite source (60% of all thin sectioned axe-hammers), but they become much less important as one moves further away. Beyond 40km from Hyssington, Group XII axe-hammers form less than 50% of the total finds in any 10km band, beyond 90km this falls to less than 20% and beyond 130km less than 10%. There is also some evidence for a rather more rapid fall-off in relative numbers as one moves west into Wales than east into England, although sample sizes are too small to be certain that this is meaningful.

Analysis of this distribution by Orton (1980: 121) led to the conclusion that it reflects small-scale local production, probably with direct or

Fig. 3.
Distribution of
axe-hammers and
battle-axes in
southern Britain.
Data derived from
Clough and Cummins
(1988).



close contact between producer and user; the outliers to the core distribution, however, suggest that some long-distance exchange or down-the-line trading was also involved.

Hyssington is one of very few rock sources exploited in the Early Bronze Age for axe-hammer manufacture which does not have its origins in the production of Neolithic implements. Indeed, the only other axe-hammer production source which seems to have had its genesis in the same period is that of Group XIV axe-hammers just 100km to the east in the Nuneaton area (Shotton 1959:136), although in this case a single Neolithic axe made from this material is known (Cummins & Moore 1988:42). Production near Nuneaton seems to have been on a smaller scale with only 28 known examples, but it is of relevance here because of the relatively close proximity of the two broadly contemporary production areas. Interestingly, while Hyssington axe-hammers are found in some numbers just west of Nuneaton, the Nuneaton axe-hammers are not found around Hyssington. It is possible that these asymmetrical distributions result from competing spheres of influence between the users of these products, although the precise chronological relationship between the use of the two sources is uncertain.

Context of Group XII Products

The majority of Group XII implements have been discovered as stray finds, but there are a number of notable exceptions. Excavation of a barrow at Garthbeibio in Montgomeryshire in 1923, revealed a central cist containing the burnt remains of a child, and a small (98 mm long) battle-axe with blunt ends. A scraper, knife and point were also found in the cist (Wheeler 1923). The small-size of this battle-axe and its blunt ends might be seen as evidence that it served as a child's toy, but McLaren (2004) cautions against such a view, noting in particular that small battle-axes also accompany burials of adults.

In 1935, the excavation of a round barrow at Chippenham in Cambridgeshire located an inhumation in a central pit, accompanied by a fine double-edged battle-axe, a bronze dagger, and a scrap of Beaker pottery. The individual was buried on their left side, with the battle-axe in a position such that, if it were hafted when buried, it might have been held in the corpse's right hand (Leaf 1935). Other examples have been found in a barrow on Windmill Hill, Wiltshire, with seven skeletons and a

pygmy cup (Mereweather 1851, 44), and beside the head of a primary inhumation in a barrow at Rolleston, Wiltshire (Colt Hoare 1812:174). Fiona Roe (pers comm.) also notes the discovery of a Group XII battle-axe with a cremation in a barrow at Church Lawton, Cheshire, although this remains unpublished. Of the many stray finds, one is of particular interest, an axe-hammer found near Llwydiarth Esgob on Anglesey in 1860 (Morgan 1874:301). This was discovered at the site of another picrite outcrop (Jana Horák pers comm.) and, given the rarity of this rock type across Wales, one is left to speculate as to whether this specimen was deposited here in recognition of the physical similarity between it and the surrounding geology.

Field survey

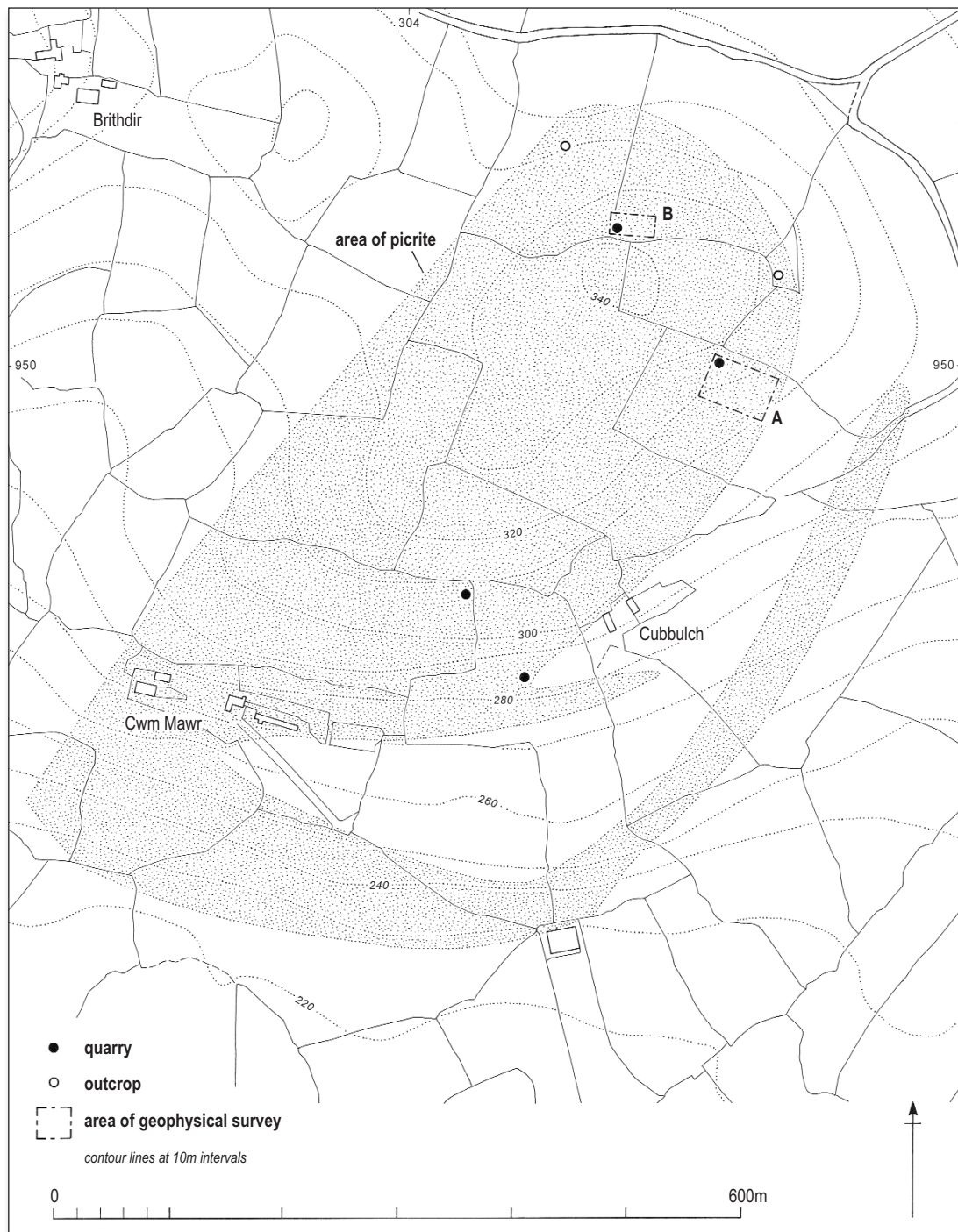
Systematic field survey was undertaken in 2007, covering the area of the picrite outcrop (c. 30ha), to identify and record those sites already thought to be potentially associated with the axe factory, as well as prospecting for further potential sites. This confirmed the presence of several small quarries and outcrops within the area where picrite had been identified by the Geological Survey (*Fig. 4*).

Shotton and his collaborators had already identified two potential sites on the hill, Site 1 (SJ 30729508), a small outcrop on the east side, and Site 2 (SJ 30679501), a small quarry to the south-east. The former, located in a small plantation, shows no obvious sign of having been worked. The small quarry appeared to be a much more promising location, measuring 11m by 8m overall and at least 1.2m deep, the base littered with picrite boulders and field clearance material. The slopes on either side of the quarry contain a series of small terraces backed by outcropping picrite which create the impression of small-scale extraction. A further outcrop was noted on the north-west side of the hill (SJ 30539519), although with no clear evidence of working, and a second quarry was identified on the northern side of the hill (SJ 30599511), sited in the corner of a field, a position possibly suggesting a more recent origin.

The field survey also revealed that field clearance had led to the deposition of surface rocks and small boulders along field boundaries, and also notably had been used for the construction of a now tumbled field wall separating the two ownerships on the hill. Although some of the clearance stone consisted of picrite, the majority was composed of other igneous rocks, together with sedimentary rocks, typical of the area to



Fig. 4.
Outcrops and
potential quarry sites
within the area of picrite,
as defined by the British
Geological Survey (1991).



the north-west of the picrite outcrop, suggesting that they were likely to have been the result of glacial deposition. The nature of the field clearance material is significant as it suggests that there may have been very little picrite which was readily accessible, other than from a quarried source.

Picrite boulders were also used to provide footings for farm buildings at Cubbulch, just downslope from the outcrop, and at a point to which boulders could be easily rolled, but this material was not used in the buildings' super-structures.

Geophysical and topographical surveys

Magnetometer survey was undertaken in 2007 to investigate the two small quarries, on the north and south-east sides of the hill. It had been hoped that the survey might reveal some indication of occupation and activity, possibly identifying hearths or areas where the rock had been quarried using a technique known as 'fire-setting', in which an outcrop is heated and then rapidly cooled with water, causing the rock to crack. However, neither of the surveys pro-



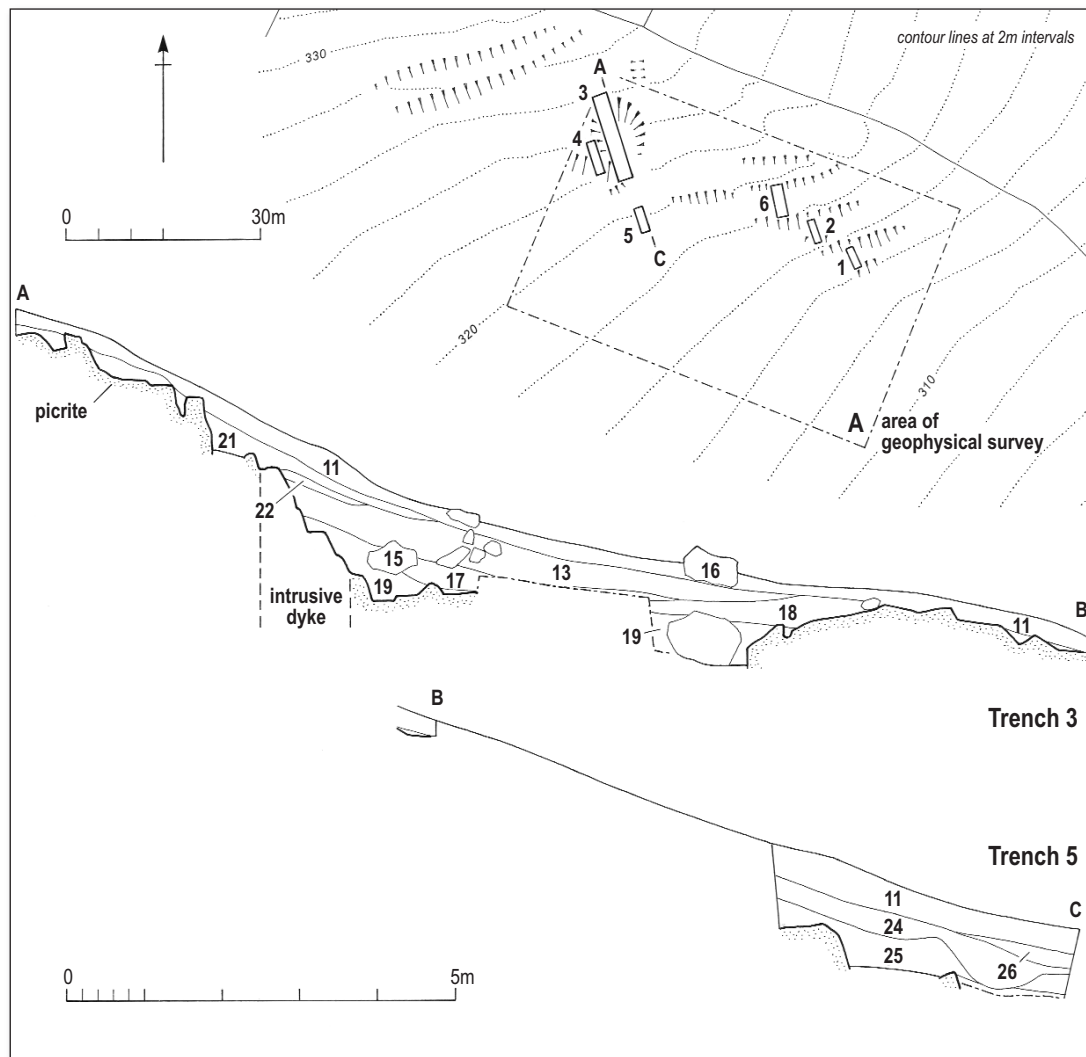


Fig. 5. Section of the main quarry excavation and topographical survey showing the areas of small-scale quarrying and the trench locations.

duced any evidence which could help to focus trial trenching, the results largely reflecting the underlying geology and the recent accumulation of debris within the two quarries.

Detailed topographical survey was completed at the same time to record the earthworks and setting of those features on the south-east slopes of the hill that might be related to the axe factory (Fig. 5).

Excavation

Small-scale, hand-excavated trial trenching in September 2007 investigated three sites on the south-eastern side of the hill, including the small quarry which had been highlighted in the 1950s as a potential stone source (Trench 3). The remaining trenches (Trenches 1–2) investigated two potential quarry scoops further to the south-east, in both cases confirming that blocks of picrite had been removed, but providing no evidence for the dating of that activity.

The second season of excavation in September–October 2008 focused on the obvious quarry, reopening and expanding Trench 3. The quarry measures 11m by 8m overall and has a number of picrite boulders visible in the base, possibly resulting from later field clearance. The new trench extended across the full length of the quarry and measured 13.5 by 2.5m, taking in almost half of the visible earthwork.

The quarry, which was sited on sloping ground, had removed a depth of up to 2m of bedrock. The base of the quarry was exposed by the excavation against its upper and lower faces. The central section was not excavated fully due to the presence of a large boulder. An examination of the exposed quarry face clearly demonstrated that individual blocks of picrite had been prised away, presumably using levers and wedges, without resorting to breaking up the rock. The base of the quarry was infilled with a deposit of yellow-brown clay silt (19), up to 0.4m thick, within which was a large boulder. An iron object, possibly a knife blade, was recovered from this layer.



At the south-eastern end of the quarry this deposit was sealed beneath a significant quantity of loose, freshly-broken picrite (18), which yielded a number of iron objects. It is perhaps most likely that this material resulted from roughly dressing stone before it was removed from the quarry, although the stratigraphical relationship within the quarry suggests that this must have been associated with a later phase of activity, rather than the primary working. It was also notable that two of the large boulders lying within the quarry showed signs of significant fracturing around the edges, possibly indicating attempts to reduce their size.

In the central section of the quarry the fractured picrite layer was sealed by a greyish-yellow, fine clay silt (17), which had accumulated around two iron shovels, and against a dump of large boulders (15). The upper fill of the quarry consisted mainly of a clay loam (13), up to 0.25m thick, which produced fragments of clay pipe and post-medieval pottery, with two further thin deposits (21 and 22) at the north-western end, and a thin deposit of topsoil (11),

which had developed around a dump of picrite boulders (16) that had the appearance of later field clearance. One block of picrite which protruded through the topsoil near the northern end of the trench had numerous linear markings, which were later identified as potentially prehistoric carvings.

The excavations gave the opportunity to examine a large expanse of picrite bedrock, which was taken up by Dr Rob Ixer, from Birmingham University. The north-western end of the quarry revealed a particularly interesting geological feature which could explain why quarrying stopped at this point. The near-vertical face of the quarry followed the line of an intrusive dyke running from north-east to south-west, where molten rock had been forced along a fault in the bedrock, resulting in the weathering and decomposition of the picrite on either side. This process would have been partly the result of the ingress of water along the dyke, with the picrite weathering to form grits and eventually clays. Unlike the opposite quarry face, which was solid picrite, the edge of the

Fig. 6.
The quarry excavation
(Trench 3) showing the
carved stone bottom right
(Photo: CPAT).



quarry at this point was largely composed of clay and decayed rock.

Another trench (Trench 4) was excavated immediately to the south-west of Trench 3 to investigate a levelled area which it was thought might have resulted from the deposition of spoil excavated from the quarry. The results, however, gave no indication for the deposition of spoil and instead revealed that the picrite bedrock was again relatively close to the surface, with a large, split boulder possibly responsible for the build-up of the soil that created the level area. This boulder had a number of linear marks similar to those identified on a stone towards the top of Trench 3.

The line of the south-west-facing section of Trench 3 was extended to the south-east to include a prominent break of slope, which was the subject of further excavation (Trench 5). The trench was excavated to a depth of around 1m, revealing the picrite bedrock, the extent of which coincided with the break of slope visible on the surface. Blocks of picrite had evidently been removed from the bedrock, which was sealed beneath a layer of firm, yellow silty clay (25). Again no datable material was recovered.

A prominent layer containing numerous small fragments of relatively freshly broken picrite (24) sealed layer 26 and also infilled a possible gully, the position of which suggests that it may be associated with a former field boundary following the break of slope. The nature of the picrite within this deposit was very similar to that observed in the backfill (18) of the quarry in Trench 3, suggesting that this material was derived from post-medieval quarrying.

A final trench (Trench 6) was excavated to investigate another small quarry scoop in the same area as Trenches 1 and 2 in 2007. As before, this revealed that the bedrock was close to the surface and that blocks of picrite had been removed, although again there was no evidence to date this activity.

Carved stones

The excavations revealed several stones bearing numerous carved lines which were examined on site by both archaeologists and geologists. In three cases the stones in question were picrite, including a large block from Trench 3, a split boulder in Trench 4 and a loose block in Trench 6. A fourth example was found on a smaller piece of sandstone (290 by 160 by 75mm) which was recovered from Trench 5. Unfortunately, none of the examples was well

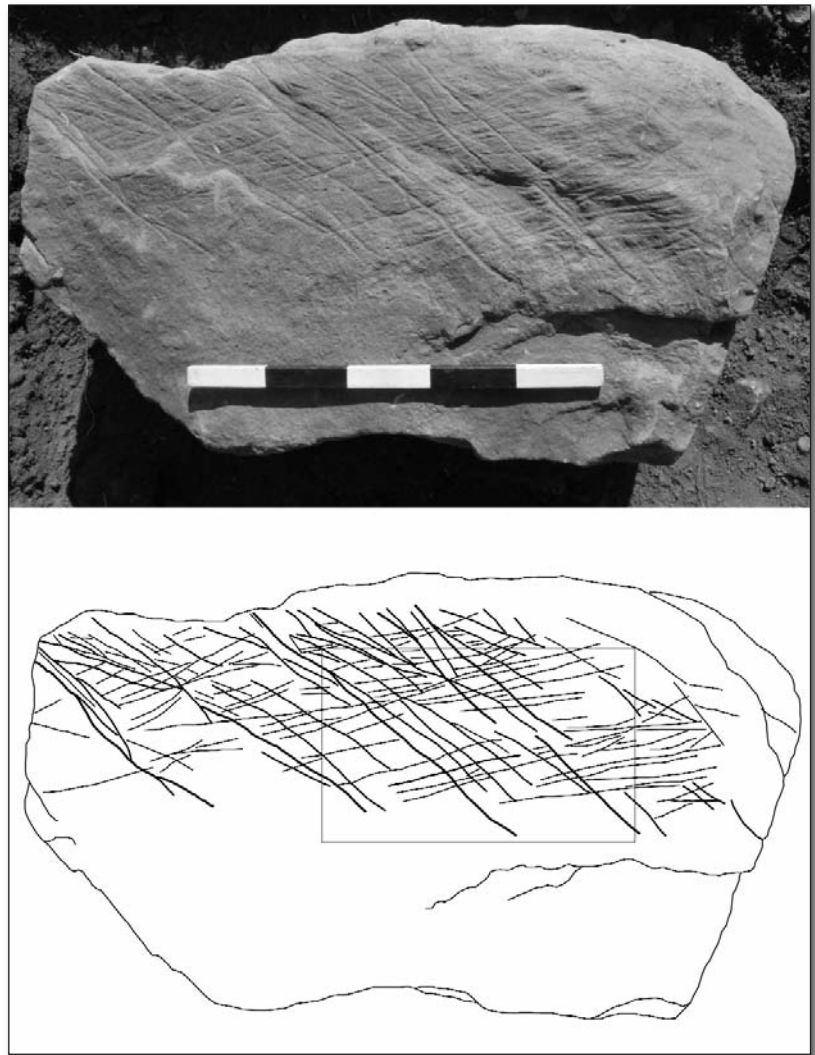


Fig. 7.

(a):

The picrite block from Trench 3 showing incised decoration (Photo: NMW);

(b):

the pattern of the incised decoration showing location of detailed photograph

Fig. 8.

stratified. The presence of 'designs' on two different rock types argues against a geological origin for these features. The potential significance of the carvings was not appreciated fully until after the completion of the excavation, with the result that a detailed study has only been made of two of the stones.

One of the stones, the large block from Trench 3, was re-examined in October 2009 at which time the stone was exposed completely so that each face could be examined in detail. The block measured around 1.0m long by up to 0.45m wide and 0.42m thick, with a trapezoidal cross-section. It lay directly on top of the weathered bedrock at the upper end of Trench 3 (see Fig. 6) and had been partly buried by a build up of hillwash, up to 0.35m thick, on the upslope side. The upper surfaces, together with one end, were seen to be partly covered in numerous carved lines, while the lower surfaces had no markings. The distribution of the carvings suggested that they had been made with the block lying in situ, and the markings extending down each face as far as the turf line.





Fig. 8.

The picrite block from Trench 3 showing detail of the incised decoration (see Fig. 7b for location; Photo: NMW)

Fig. 9.

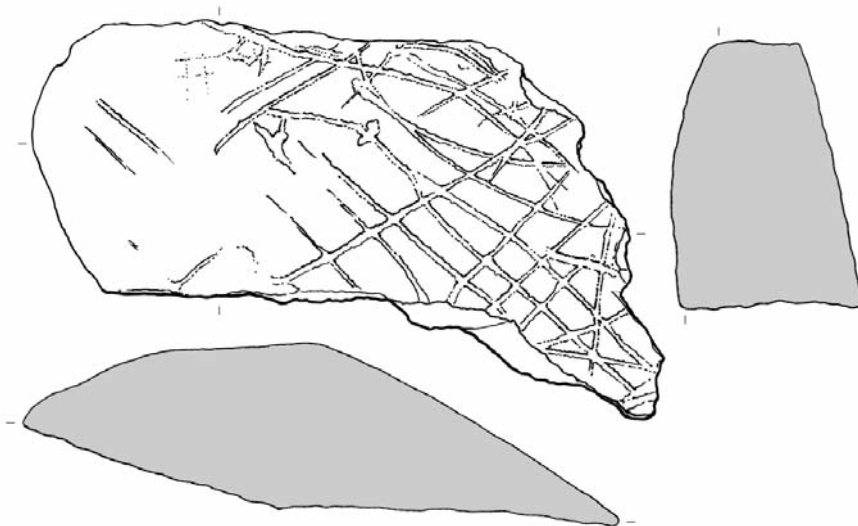
Incised decoration on sandstone block from Trench 5.

One face contained significantly more lines than the others, forming an obvious cross-hatched pattern which extended to the edges of the face. The lines follow two main alignments with one direction (*from top left to bottom right in Fig. 7b*) having more numerous lines, which were also generally narrower and shallower than those in the opposing direction. The latter appear to have been spaced to form deliberate divisions between 95mm and 105mm apart, using broader and slightly deeper incisions, up to 6mm across and perhaps 2mm in

depth. Several of these lines appear to contain striations running along their length which are suggestive of tooling marks. It was not possible, however, to determine the sequence in which the lines had been carved.

The sandstone block (Fig. 9) measures 275mm by 175mm by 85mm thick. The upper, carved, surface is smooth and weathered, the others are fractured, indicating that the piece has broken from a larger block. The carved pattern extends to the edge of the surviving upper surface proving that at least one of these breaks postdates the carving itself. The design is very similar to that on the larger picrite block, with lines arranged along two main alignments, broadly at right angles, but with additional lines adding variation to this pattern.

The designs, chiefly cross-hatched, resemble those found at Neolithic sites such as Ness of Brodgar, Quoyness and Skara Brae on Orkney and at Millin Bay, Co Down in Ireland (Shepherd 2004: Figs 12.5–12.10; O'Connor, pers. comm. 2008). Although the designs on the stones at Hyssington cannot be directly dated, detailed study of those on the sandstone example show that they were made by pecking rather than incising, suggesting a prehistoric rather than a later date. Parallels have been sought from later periods, but without success.



Conclusions

The work undertaken by Shotton and his collaborators in the 1950s appears to leave little doubt that the small hill near Hyssington is the source of the picrite used to produce the Group XII battle-axes and axe-hammers. The recent investigations have confirmed a number of potentially prehistoric extraction sites on the hill, consisting of small-scale workings on the south-east side of the hill, an area which was also favoured by Shotton and his colleagues as worthy of further study.

Although the investigations have not confirmed the precise site of prehistoric stone extraction, the results from the trial excavations have clearly demonstrated that picrite has in the past been quarried across an area of around 65 by 20m. Although the field evidence suggests that working was restricted to small-scale extraction sites, possibly implying a rather sporadic approach, there is no doubt that a significant quantity of picrite could have been removed. It is not possible, however, to determine the level of the original land surface, although it may be presumed that outcrops of picrite were perhaps rather more visible than at present. Unfortunately, the excavations failed to recover any artefactual evidence or other dateable material to indicate the likely date of these workings.

Despite the lack of any direct evidence, this part of the hill still represents the most likely source of stone for the picrite axes. The lack of artefactual evidence in part is due to the nature of the picrite, which is likely to have been extracted using no more than wooden wedges and worked using a percussive technique which would not result in the working flakes typical of other axe factories. In addition, it is quite conceivable that the stone may have been worked at a separate location which would only come to light through the chance discovery of rough-outs and wasters.

The unexpected discovery of a number of stone carvings in close proximity to the areas of extraction has given new significance to the site. The decoration, which consists of numerous parallel and crossing lines, is similar to examples found in Neolithic contexts in Scotland and Ireland. Although none of the discoveries were from well-stratified contexts, and cannot therefore be confidently associated with quarrying activities, their presence does appear to confirm significant prehistoric activity on the south-east side of the hill, even if their meaning is lost to us.

No further fieldwork is envisaged as part of the present project and it must therefore be hoped that future discoveries will eventually confirm the site of prehistoric workings.

Acknowledgements

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Does size matter?

Stone axes from Orkney: their style and deposition

Abstract

The number of Neolithic stone axes known from Orkney has increased significantly over the past couple of decades. Numbers have grown as a consequence of continued field investigation, but also because of access to axes held in private collections which have not been recorded before. The volume of known and recorded examples is now sufficient to explore the relationship between axe blades and their contexts. Attention in this paper focuses upon the raw materials and forms chosen for individual axe blades, and the relation that these have to the manner and circumstances of deposition. The resulting patterns suggest a considerable variety in the paths that carried axes into the earth; from prosaic patterns of breakage and loss to more purposive acts of interment.

The story so far

Recent excavations in Orkney have almost doubled the known number of stone axes since Roy Ritchie’s last published list (Ritchie 1992). This group of stone axes exhibits a wide range of shape and raw materials and a large proportion, some 64%, are from excavated contexts at settlement or funerary sites. Given the richness of detail available the intention here is to go beyond the standard ‘source and distribution’ aspect of stone axe studies and instead take a broad view of how the axes may have been used by exploring the relationship between the *style* of axe, by looking at the choice of stone and shape, and the *means of deposition* of these tools.

First find your axes

The group of axes to be discussed below was compiled from a variety of sources: excavation reports; lists produced by Roy Ritchie and Stephen Harrison; and from recently excavated but unreported finds (see acknowledgements) (Table 1). This list cannot claim to be exhaustive and there must be many axes in private hands in Orkney that are unknown to archaeologists. During a visit to Orkney this summer I was shown two unusual polished stone tools that had been ‘found in Uncle Willie’s toolbox’ and which were thought to have been there for at least 60 years. Colin Richards has also commented on the ‘remarkably high number of small collections of flint, stone and bone artefacts still to be found in small tin boxes on the shelves of Orcadian farmhouses’ (Richards 2005:8). Some of the axes were not seen for various reasons but where possible, information was taken from illustrations and other catalogue entries. Those axes that have not been recorded at all are unlikely to have an archaeological context and for this reason they would be of limited value to this study. What we do have is complete information on all axes that were found through excavation up to September 2008 and a full catalogue has been

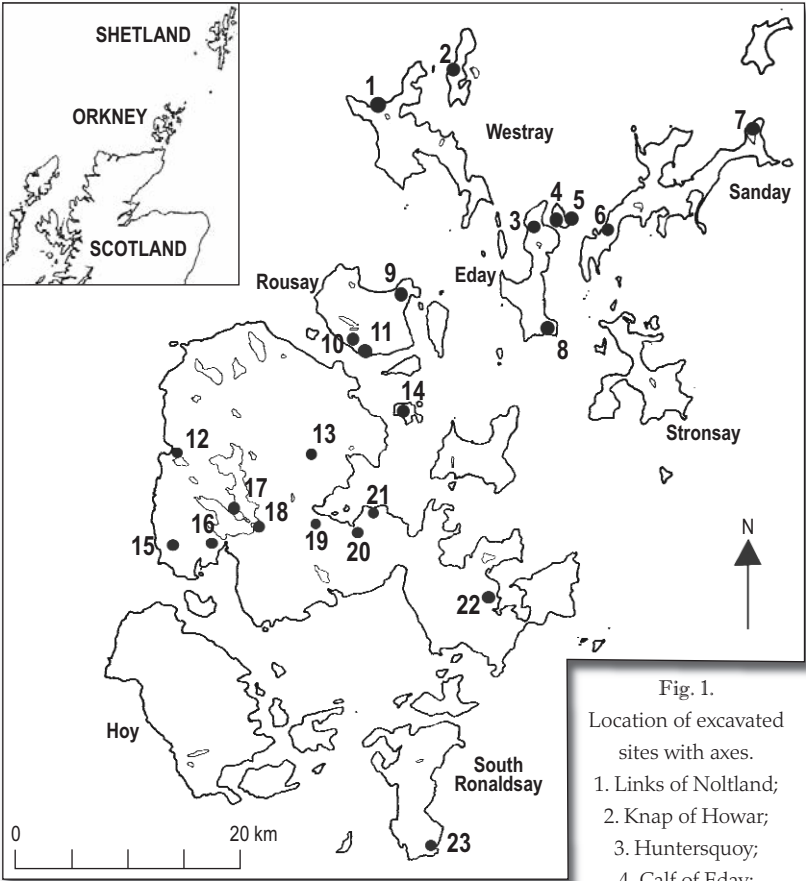


Fig. 1. Location of excavated sites with axes.

- 1. Links of Noltland;
- 2. Knap of Howar;
- 3. Huntersquoy;
- 4. Calf of Eday;
- 5. Calf of Eday Long;
- 6. Pool;
- 7. Tofts Ness;
- 8. Green;
- 9. Rinyo;
- 10. Knowe of Laird;
- 11. Blackhammer;
- 12. Skara Brae;
- 13. Knowes of Trotty;
- 14. Braes of Ha'Breck;
- 15. Mousland;
- 16. Howe;
- 17. Ness of Brodgar;
- 18. Barnhouse;
- 19. Stonehall;
- 20. Wideford Hill;
- 21. Crossiecrown;
- 22. Long Howe;
- 23. Isbister.

lodged with the Implement Petrology Group. The axes are identified by their catalogue code in the text and a site location map is presented in Fig. 1. Primary references to published material are given in Table 2 to avoid repetition in the text.

A comment on axe size and collection bias

It is a common perception amongst researchers of the Orcadian Neolithic that the stone axes found around these islands are small in size, almost miniature in form. Indeed, Roy Ritchie has noted that in comparison with axes from the neighbouring archipelago of Shetland those from Orkney had a smaller size range with

	Complete axes	Axe fragments	Axe flakes	Total
Stray axes:				
Orkney	12			12
Parish	13	1		14
Find spot	22	6		28
Excavated axes:				
Settlement	47	25	9	81
Funerary	10	3		13
	104	35	9	148

Table 1. Stray and excavated axes.

	Complete axes	Axe fragments	Axe flakes	Total	Primary site references
Settlement sites:					
Skara Brae, Sandwick	19	3	1	23	Childe 1931, Clarke 1976, Petrie 1868
Barnhouse, Stenness	1	7	3	11	Richards 2005
Stonehall, St Ola	5	3		8	Richards and Jones forthcoming
Braes of Ha'Breck, Wyre	3	5		8	Antonia Thomas pers comm.
Pool, Sanday	4	2		6	Hunter et al 2007
Ness of Brodgar, Stenness	5			5	Nick Card pers comm.
Tofts Ness, Sanday	3		2	5	Dockrill et al 2007
Wideford Hill, St Ola	1	3		4	Richards and Jones forthcoming
Rinyo, Rousay	2		1	3	Childe and Grant 1939, 1947
Crossiecrown, St Ola	2	1		3	Richards and Jones forthcoming
Green. Eday	1			1	Mick Miles pers comm.
Knap of Howar, Papa Westray	1			1	Ritchie 1983
Links of Noltland			1	1	Sharples 1982
Knowes of Trotty, Harray*		1		1	Card and Downes 2002
Long Howe, St Andrews*			1	1	Robinson and Woodward 2007
Chambered tombs:					
Isbister, S Ronaldsay	3			3	Hedges 1983
Howe, Stromness	1	1		2	Ballin Smith 1994
Calf of Eday Long, Eday	2			2	Calder 1937
Calf of Eday, Eday		1		1	Calder 1938
Huntersquoy, Eday		1		1	Calder 1938
Blackhammer, Rousay	1			1	Callander and Grant 1937
Knowe of Lair, Rousay	1			1	Grant and Wilson 1943
Bronze Age burial mounds:					
Knowes of Trotty, Harray	1			1	Card and Downes 2002
Mousland, Stromness	1			1	Downes 1994

Table 2.
Excavated sites with axes.

*Found in contexts
which suggest non
funerary activity.

lengths clustering at around 70mm whilst those from Shetland peaked around 150mm (Ritchie 1992:214). Comparison with axes from the rest of Scotland is not possible because although there are an estimated 4000 axes held in various collections (Sheridan 1992) there has been no attempt as yet at a complete synthesis of these finds so that whether the Orkney axes are indeed smaller than your average axe remains unverified. Roy Ritchie described the miniature axes from Orkney as being <70mm in length, often well made with faceted sides and broad butts and he commented that this was a well known type of axe with similar examples from the axe factories at Killin, Langdale and Antrim (Ritchie 1992:214). Furthermore, he observed that the axes had been deliberately made that size; they were not small because they had been reduced in size from reuse (ibid). For the moment then, we could surmise that though small axes are present and indeed well known outside Orkney they perhaps occur more frequently at Orcadian sites.

The above observations about the size of axes are all the more interesting because of the group of axes from which the statistics were derived. When Ritchie wrote about the axes from Orkney he had an estimated total of 80

axes (Ritchie 1992:214) of which 45% came from excavations. A number of recent research and rescue excavations have now increased the total of known axes to 148 of which 64% have been found during excavation and the rest as stray finds (Table 1). Most of the axes found during these recent excavations are in fact amongst the smallest to have been found since Ritchie wrote about them in 1992 and the increasing number of these smaller axes supports the previous observations of their frequency in Orkney.

A plot of the lengths of all the complete axes indicates that the group of axes found as stray finds had a wider size range than the excavated axes and larger ones were more common (Fig. 2). In contrast the excavated axes tended to concentrate at the smaller end of the size range. This disparity in dimensions between the stray and excavated axes is interesting. It is to be expected that the larger, unbroken axes picked up over the years would have found their way into museum collections but there is also an observable hierarchy amongst museum collections themselves: the axes from the two biggest museums in Scotland (National Museum of Scotland, Edinburgh and the Hunterian Museum, Glasgow) tended to be larger than those from the Orkney museums of Tankerness

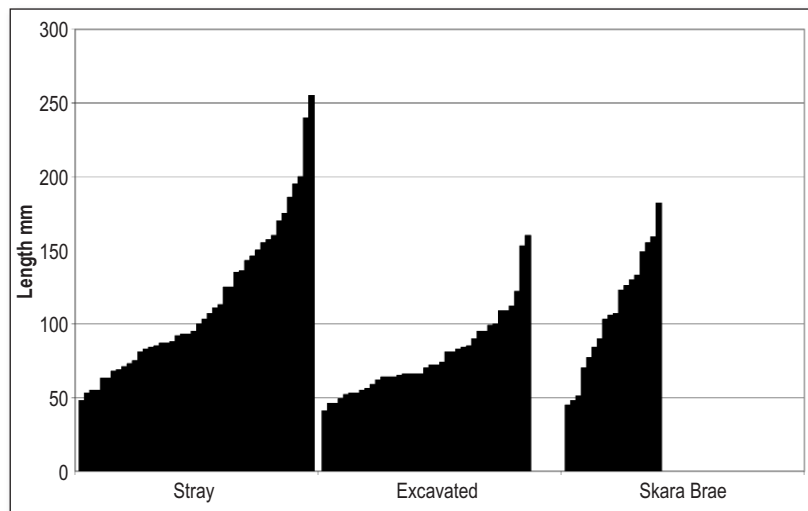


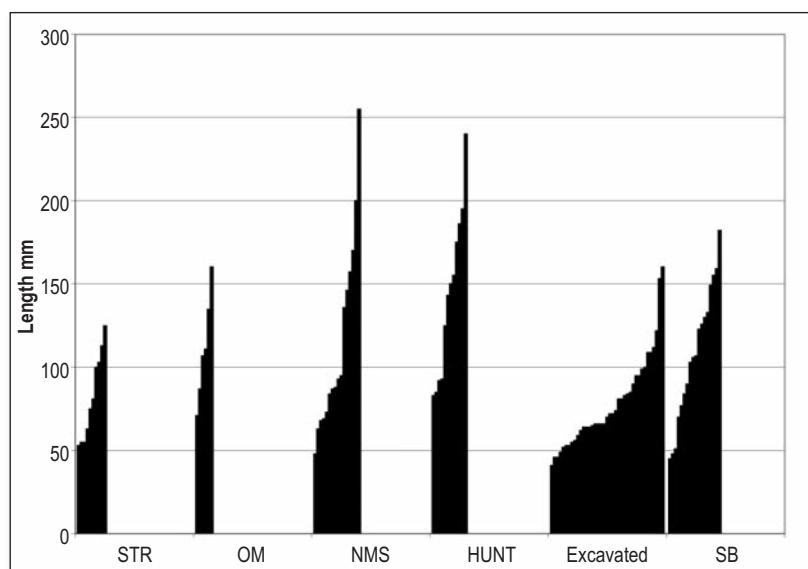
Fig. 2.
Lengths of complete axes
by retrieval method.

House and Stromness (Fig. 3). This pattern is of course a relic of past acquisition strategies of the national museums but it has clear implications of bias depending on how a researcher selects a 'sample' of axes to measure.

Excavation procedures can also bias the collection of artefacts and this may have affected the group of axes found at Skara Brae. The large number of axes from this site (Table 2) reflects not only the close interest paid to it by archaeologists in a series of excavations that spanned a century (Petrie 1868; Childe 1931; Clarke 1976) but also the great depth and spread of archaeological deposits. It is uncertain though just how representative this sample of axes is of those that were actually deposited at the site in prehistory because the excavation techniques of the later 19th and early 20th centuries are likely to have biased collection against smaller axes and axe fragments. There are also several axes amongst this group that cannot be related to those mentioned in the excavation reports

Fig. 3.
Lengths of complete axes
by museum collection.

STR:
Stromness Museum,
Orkney;
OM:
Orkney Museum;
NMS:
National Museum of
Scotland;
HUNT:
Hunterian Museum;
SB:
Skara Brae.



so they must remain uncontexted. The size distribution of this group of axes from Skara Brae is most similar to that of the stray axes (Fig. 2) which would suggest that they had indeed been subject to some sort of collection bias. Other settlement sites are not so affected by differential retrieval of finds because they were subject to more rigorous excavation procedures from the 1970s onwards.

Choosing and getting the stone

Apart from comments on their diminutive size there has been little else said about the axes from Orkney and this is because this group of islands does not feature strongly on distribution maps of the products of axe factories. There is an axe of porcellanite from Antrim (XX/ORK.12) (Sheridan 1992) whilst macroscopic identifications by Roy Ritchie of an axe made of riebeckite felsite from Shetland (XX/ORK.10) and one of Group VI material from Great Langdale (XX/SR.1) have not yet been supported by thin-sections. These three axes are all stray finds as is a large flint axe from Folsetter, Birsay (FO/BI.1), the double-ended axe of possible serpentine (XX.SA.1) and one of hornblende (XX/OR.1) all of which must be imports.

So what can be said about the choice of stone for making axes? Although no strict program of geological identification has been carried out on the axes for this research there are a few observations to be made on the selection of the stone. First of all, on the basis of many years experience of trawling through large collections of coarse stone tools from the Northern Isles I would suggest that most of the stone for the axes was likely to have been derived from around Orkney taking advantage of the variations in geology across the islands. The lithology of the sedimentary rocks varies widely from hard grey micaceous sandstones of the Stromness Beds to soft light-coloured sandstones and siltstones of the Eday Beds together with finely-bedded black, fossiliferous flagstones of the Rousay Beds. The hard igneous rocks such as bostonite, monchiquite, camp-tonite and basalt come from the igneous dykes and volcanic vents that are exposed around much of the coastline of Mainland, Rousay, S Ronaldsay and Hoy whilst meta-igneous rocks such as granite, gneiss and schist occur on the west coasts around Yesnaby, Stromness, Graemsay and on the north coast of Hoy (Mykura 1976).

No quarries, or at least extraction areas for the raw material for axes, have yet been iden-



tified in Orkney. This is in contrast to the evidence for the quarrying of an igneous dyke at Beorgs of Uyea, in Northmaven, Shetland to produce blocks of riebeckite felsite for the manufacture of polished axes and Shetland knives (Scott & Calder 1952; Ritchie 1968). It is probable that igneous dykes and sandstone exposures were worked directly for some of the axe stone in Orkney but it is uncertain just what traces would have been left from their exploitation. Since there do not appear to be very many axes of one single type of rock then the level of exploitation at an extraction site may not have been intense enough to leave behind much evidence for the archaeologist. Perhaps more common use was made of a cobble source of stone for the axe blanks; 14 of the axes had some indication that they were made from cobbles and these included both sedimentary and igneous rocks as well as all five of the quartz axes.

At most of the sites a range of rock types were exploited including the fine-grained sedimentary rocks and grey igneous rocks. However, at Braes of Ha'Breck and Wideford Hill it appears that just siltstones were used; this may be a feature of Early Neolithic settlement.

The inhabitants often appeared to have chosen rocks that had quirky attributes in patterning or texture or something that gave the axe some individuality. This can be created by choosing banded and speckled stone. On one axe a broad band of white quartzite on a grey background is carefully placed to curve around the blade on the more rounded face of the axe (NE/RO.1). A cream coloured band on a grey background also features on the rounder face of an axe (this is the possible Group VI axe XX/SR.1). On the fragment of a chisel axe narrow bands of light and darker grey sandstone were made to run parallel to the length of the

tool (SH/SO.1) whilst on an axe fragment (WH/SO.2) the narrow bands run diagonally across the axe. The vulnerable nature of this obviously bedded stone is seen on the latter axe as it has broken along a bedding plane. Black and white speckled or mottled stone has been selected for two chisel axes (SA/SO.2, XX/ORK.3) and a fine axe from Crossiecrown (CC/SO.1) as well as two stray finds (LM/SY.1, XX/FL.1). It was also used at Barnhouse as evidenced by the three flakes detached from polished axes (BH/ST. 9–11).

Another noticeable trait in a few axes is the presence of crystals. Three axes had crystal inclusions which formed pockets in the grey parent rock (BL/RO.1, HU/ED.1, NB/ST.3) and an unfinished axe was made from a cobble of light coloured rhyolite or quartz porphyry which had crystals scattered throughout the matrix (SH/SO.10). The crystals cause the axes to sparkle.

Yet another characteristic of some of the stone is redness. The most obvious is the axe of haematite (IS/SR.1). Though very dark in colour and very hard and dense in physical makeup, haematite has an interesting property in that it can be used as a pigment. When used dry it can be rubbed against a hard surface to produce a powdery red mark. However, when used wet it produces a rich dark red liquid which resembles blood, thus giving the rock its name (Isbister 2000: 193). On an axe of grey stone (SB/SAN.8) there were traces of red pigment, most likely haematite, visible on both faces. On another axe (SB/SAN.13) a reddish brown patch features on the curved face. On all three of these axes it is tempting to link red colour with blood.

White quartz was selected for five axes (CC/SO.2, SA/SO.1, SB/SAN.6, SH/SO.3, XX/GR.1). They all shared a significant feature in that the blade of each axe was blunted by being deliberately rounded and polished.

Another quirky feature is the apparent unsuitability of some stone types for use as an axe. These include the group of axes made from light coloured cream/ grey micaceous siltstones from Braes of Ha'Breck, Wyre (BOH/WYR. 1–8) (*Photo 1*) and one from Green, Eday (GR/ED.1) which would appear too soft for conventional axe use. Darker coloured siltstones may have been used for some axes from Wideford Hill (WH/SO.1–2, 4). Another axe from Mousland (MO/STR.1) (*Photo 2*) is very soft in texture and is thought to be of steatite (Downes 1994) though it could possibly have been made from chalk.

Photo 1.
Axes from Braes of
Ha'Breck, Wyre.
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Photo 2.
Axe from Mousland,
Stromness.

Shaping the axe

Whatever the source of stone there is some indication that axes were made, or at least finished, at settlement sites and this is in the form of a small number of possible axe roughouts (not included in the catalogue) from Pool, Stonehall and Skara Brae which appear to be simply blocks of stone that have been roughly pecked with no further shaping (Clarke 2007a; Clarke forthcoming a and b). Grinding slabs are also a feature at some settlement sites and the slab from the Early Neolithic phase at Stonehall was almost certainly used for grinding axes as it has a slightly concave band of smoothing and striations some 45mm wide that run down the length of one face (Clarke forthcoming a). Another grinding stone and a probable polishing stone were found at Ness of Brodgar whilst grinding slabs that may have been used for

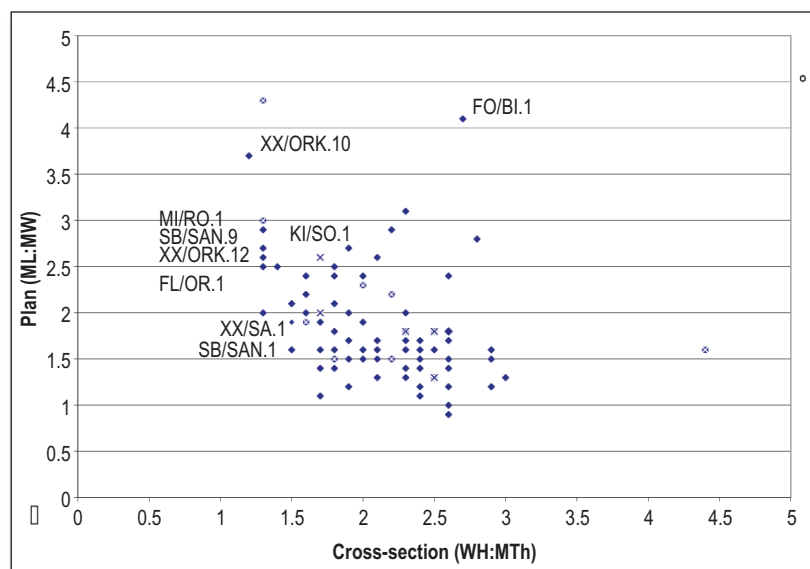
shaping axes also come from Barnhouse and Wideford Hill (Clarke 2005; Clarke 2007c; Clarke forthcoming a). Polissoir fragments were also found during excavations in 2010 at Braes of Ha'Breck, Wyre (Antonia Thomas pers comm.)

Discussion of axe shape can be very confusing as variation upon variation of what are essentially sub-rectangular blocks of stone with or without interestingly-shaped butts are squeezed into seemingly endless shape categories. To simplify things here, the plans and cross-sections of all the complete axes have been presented as ratios and plotted together (Fig. 4). At first glance there seems to be considerable variation in shape encompassing long and thin axes with rounded cross-sections to short and wide axes with flat cross-sections. This spread can be rationalised by interpreting it as a cluster with outliers. Identifying the individual axes that appear on the outskirts of the cluster is informative and demonstrates three main groups of axes (Figs. 5–7). First of all there are the 'exotic' axes which include the double-ended axes (KI/SO.1, XX/SA.1, XX/ORK.10), those with expanded blades (FL/OR.1, SB/SAN.1) or possible copies of an Irish type (MI/RO.1) as well as those axes made of imported stone such as flint (FO/BI.1, BA/SAN.1), porcelanite (XX/ORK.12) and hornblende (XX/OR.1). These are all stray finds and they tend to be rounder in cross-section and more elongated in form than the main cluster (Fig. 5). At the next level are the axes found as 'deliberate deposits' in structures and in chambered tombs (Fig. 6) (see below). Some of these, such as the chisel axes (BH/ST.1, SB/SAN.15) and the long, flat axe (SB/SAN.9) are extreme outliers whilst the other axes from settlement sites (PL/SA.4, CC/SO.1, SH/SO.3, NB/ST.3, TN/SA.3) are either incorporated into the main cluster or, more commonly appear on the edge. The axes from the tombs also occur mainly within the cluster but tend to be amongst the more elongated of this group. Finally, there is the general grouping of the rest of the axes which includes most of the faceted forms (Fig. 7) (Photos 2 and 3).

A significant morphological feature on many of the axes is the presence of flat facets that have been ground on the sides and/or butt of an axe and these are present on just under one third of the total number of axes. The finest forms of faceting occur on axes from Braes of Ha'Breck, Wideford Hill and Ness of Brodgar and at these three sites the greater proportion of the axes have been shaped with facets (Table 3). Faceting on axes is not nearly so common at sites of the later Neolithic and, with the exception of the two axes from Howe does not occur on axes

Fig. 4.
Shape of complete axes.
Plan given by ratio of
maximum length:
maximum width.
Cross-section given
by ratio of width
at halfway point:
maximum thickness.

White crosses – axes from
deliberate deposits at
settlements;
Blue crosses – axes from
chambered tombs.
Exotic stray axes
are annotated with
catalogue number.



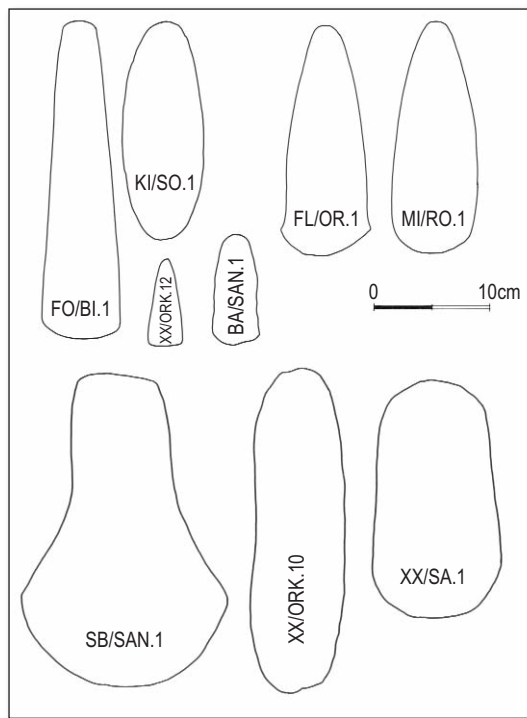


Fig. 5.
Shapes of 'exotic' axes.

Fig. 7.
Shapes of axes
in main cluster.

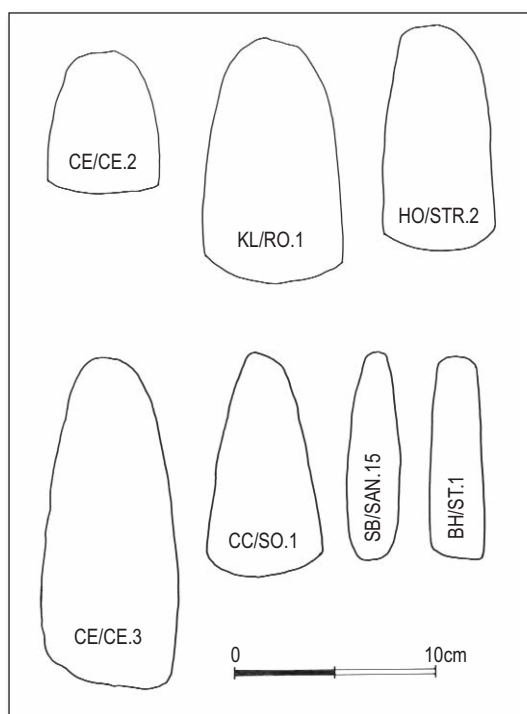
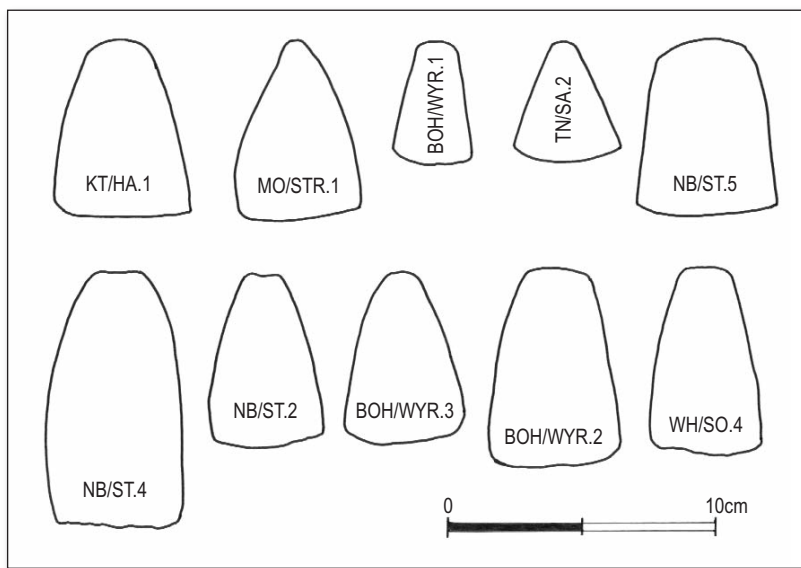


Fig. 6.
Shapes of axes from
deliberate deposits in
tombs and structures.

associated with Orkney Cromarty tombs, despite their early date of construction. Faceting of the sides, and on the narrow butt of the Mousland example, appears to reoccur in the Early Bronze Age (*Table 3*) – the Isbister axes have been provisionally placed in this phase because of their late associations in an external tomb context (see below). To this later group of side-faceted axes could be added a stray axe (SA/SO.3) made of a green igneous rock with flat faceted sides that has also been pecked at

the butt end to form slight shouldering, no doubt for hafting. Such hafting techniques are observed on large stone tools called 'handled clubs' that are associated with Bronze Age contexts of Shetland and Orkney (Clarke 2006). In general, the faceted axes have a discrete size range of about 50mm to 100mm in length (*Fig. 8*) and interestingly this is similar between the stray and excavated finds despite the differences in size between these two groups that were commented on above.



Photo 3.
Axes from Ness of
Brodgar, Stenness.
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	Faceted sides	Faceted sides and butt	Faceted butt	One side faceted	Total number of axes from whole site
EN:					
Braes of Ha'Breck		3	3		8
Wideford Hill		1	1		4
Howe?	1		1		2
LN 1:					
Ness of Brodgar		3	1		5
Barnhouse			1		11
Tofts Ness phase 1	1				5
LN 2:					
?Skara Brae	1			2	23
Tofts Ness phase 2		1			5
Neo unphased:					
Knowes of Trotty				+butt	2
Stonehall			1		8
Green			1		1
EBA:					
Isbister	3				3
Knowes of Trotty	1				1
Mousland			1		1

Table 3.
Presence of faceting
on excavated axes.

Leaving the axes behind at settlement sites

Present evidence suggests that axes from Early Neolithic sites are not closely associated with structures (Table 4). The ongoing excavation at Braes of Ha'Breck means that most of the axes found so far are from topsoil whilst the only contexted axe here came from an external midden, as did the axe from Knap of Howar. At Wideford Hill the axes had been incorporated as fragments, together with other stone tools into a working floor outside the structure. The axes from Stonehall were found in topsoil indirectly associated with the Early Neolithic structures underneath.

In contrast to the above, axes from Later Neolithic sites have been deposited in a greater range of contexts including middens and other external dumps, structural deposits and internal features (Table 4). There are some placements of axes that could be considered significant and these include axes found on floors, in recesses, in a cist and by walls (Table 6). There is no apparent relationship between the style of an axe and how it has been deposited: a chisel axe was found buried in the floor by the rear wall of the E recess in the monumental House 2 at Barnhouse (BH/ST.1) (Photo 4) (Richards 2005: 140 and figure 5.19) whilst at Skara Brae (SB/SAN.15) a chisel axe was found on the floor of an early house together with a group of other finely-made objects including a ground stone knife, decorated Skaill knife, several worked bone objects and a decorated pottery base

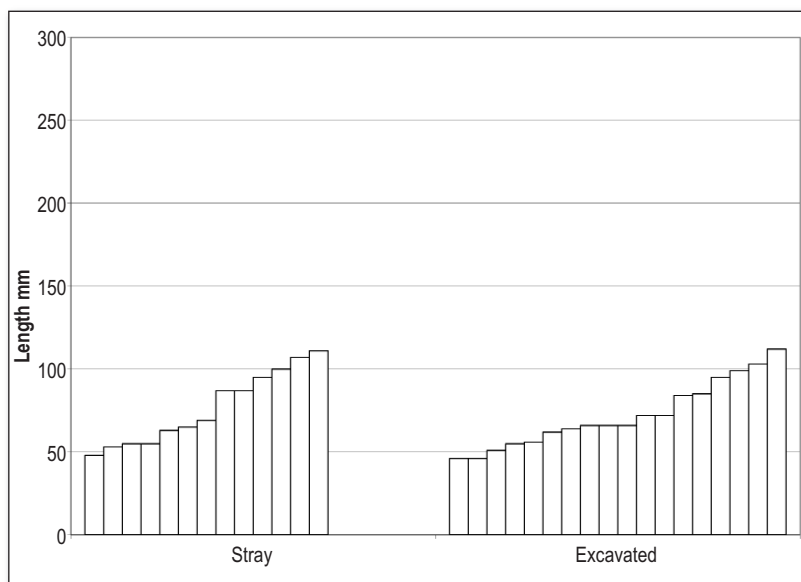


Fig. 8.
Lengths of complete
axes with facets.

(Clarke 1976:figure 5). An axe of shiny black stone was also found against an internal wall of an early house structure at Tofts Ness (TN/SA.1) and a finely-made axe of speckled stone came from the floor of a recess in House 1 at Crossiecrown (CC/SO.1). At Stonehall a fine quartz axe with a rounded blade edge (SH/SO.3) was found in a cist sunk into the floor of structure 2 together with a Knap of Howar grinder, hammerstones and flint knapping debris (ibid). There are some loose associations of axes with walls most notably an axe with crystal inclusions found on a wall at Ness of Brodgar (NB/ST.3) and the adze-like tool from Pool (PL/SA.4) found in the main wall of the monumental Structure 8. It is not just com-



Table 4.
Contexts of axes from
settlement sites.

*Not all axes from this
site have contextual
information.

	Working floor	Midden	Wall	Internal	External	Field walk/topsoil
Early Neolithic:						
Braes of Ha'Breck		1				7
Wideford Hill	4					
Knap of Howar		1				
Stonehall phase 1						3
Late Neolithic 1:						
Barnhouse				2	5	4
Ness of Brodgar			2		3	
Skara Brae Early*				3		
Pool phase 2		3				
Tofts Ness phase 1				1		
Rinyo*				1		
Late Neolithic 2:						
Stonehall phase 2		1		1		3
Skara Brae Late*		1		5	1	
Pool phase 3			1		1	
West Midden, Links of Noltland		1				
Crossiecrown				1		1
Tofts Ness phase 2		1				
Neolithic unphased:						
Green, Eday						1
Knowes of Trotty	1					
Long Howe, St Andrews					1	
Bronze Age:						
Tofts Ness phase 4		2				
Crossiecrown phase 5		1				
Skara Brae?		1				

Table 5.
Contexts of axes from
funerary sites.

Chambered tombs:	
Blackhammer, Rousay	Internal, floor of passage
Calf of Eday, Eday	Internal, embedded in clay floor
Calf of Eday Long, Eday	Internal, on bench
Calf of Eday Long, Eday	Internal, on bench
Huntersquoy, Eday	Internal, in prepared clay floor
Knowe of Laird, Rousay	Internal, floor
Howe, Stromness	Clay sealing layer over O/C tomb
Howe, Stromness	Clay sealing layer over O/C tomb
Isbister, S Ronaldsay	External, on revetment wall
Isbister, S Ronaldsay	External, on revetment wall
Isbister, S Ronaldsay	External, on revetment wall
Bronze Age burial mounds:	
Mousland, Stromness	External, by cist
Knowes of Trotty, Harray	External, by cist

	Style	Placement	Other artefacts
Late Neolithic 1:			
Barnhouse	Chisel axe	Recess H2	
Barnhouse	Speckled black/white flake	Cut for dresser Str 8	
Skara Brae Early	Chisel axe	Floor of early House	With other decorative and unusual objects
Rinyo I	Black flake	Floor Chamber E	
Stonehall	Quartz	Cist Str 2	With Knap of Howar grinder, hammerstones and flint debris
Tofts Ness phase 1	Black shiny	By internal wall Str 1	
Ness of Brodgar	Crystal inclusions	On wall	
Skara Brae Early	Quartz	(Floor H10)?	
Skara Brae Early	Black	(Floor H10)?	
Late Neolithic 2:			
Pool phase 3	Adze-like	Internal wall Str 8	
Crossiecrown	Speckled grey/white	Floor of recess H1	
Skara Brae Late	Grey	(Floor H3)?	
Skara Brae Late	Black	(W recess H1)?	

Table 6.
Axes in significant
deposits.



plete axes which are deposited in these various ways; two flakes from polished axes have been found, one from the cut for a dresser inside Structure 8 at Barnhouse (BH/ST.11) and one from the floor of chamber E at Rinyo.

Information for most of the axes from Skara Brae is sketchy; many appear to have been found inside structures (particularly since the excavation of the interior of the houses was the main aim in the late 19th and early 20th century excavations) but their precise context, whether they were for example deliberately placed on floors or were part of later reoccupation or interior dumps is not clear and it was not possible to link many of the axes with references in the texts. That said, it can be determined from Petrie's excavation plan that an axe (SB/SAN.2) most probably came from the W recess of House 1 and a large axe made on a cobble (SB/SAN.9) came from the rear of House 3 (Petrie 1868). Childe also mentions two axes coming from the floor of Early House 10 (Childe 1931), one made of quartz with a rounded blade edge (SB/SAN.6) and another of black igneous rock (SB/SAN.5).

Most of the axes considered above as significant deposits were unbroken and this is in contrast to the other axes from Late Neolithic deposits outside the structures where many from the middens, tips and other external deposits were fragments or else damaged in some way. Should these just be seen as utilitarian objects that were discarded on breakage, or can some be considered as deliberate placements? At Barnhouse there is an interesting concentration of polished tools found in an external occupation midden which included a fragment of a large chisel axe (BH/ST.4) together with a broken macehead whilst an axe



Photo 4. (left)
Chisel axe from
Barnhouse, Stenness.

Photo 5. (right)
Miniature axe from
Tofts Ness, Sanday.

fragment (BH/ST.6) was found directly underneath this deposit. At Tofts Ness the smallest and perhaps finest Orcadian axe (TN/SA.2) was also found in a midden deposit (*Photo 5*). Structured deposits of groups of materials such as articulated bone, pottery and stone tools have been observed in midden deposits at Pool (Hunter 2000:122) indicating that some of the artefacts found in the middens must have been associated with particular activities carried out at the place where the midden accumulated rather than having been discarded there from elsewhere. There is other evidence for activity surfaces on the midden at Links of Noltland in the form of a flint knapping floor and a clay oven (Sharples 1982). Perhaps the deposition of axes in such contexts should be viewed in the light of activity on the middens rather than as discarded objects.

Evidence that axes may have continued in use into the Early Bronze Age comes from the three flakes from polished stone tools found in later middens at Tofts Ness and Skara Brae (TN/SA.4–5, SB/SAN.16) and a quartz axe from Crossiecrown which came from the later rubble and midden above the Late Neolithic House 1.

Axes with funerary associations

Of the 81 chambered cairns identified by Davidson and Henshall (1989) just 29 have been excavated and of these seven tombs had finds of axes. All of the tombs with axes were of the Orkney Cromarty type and many of the axes were found inside the passage or chambers, perhaps unsurprisingly given that the internal layout has been the main focus for excavators in the past.



The axes from chambered cairns though few in number have some interesting contextual associations and they all appear to have been deliberately placed either singly or grouped in particular spots (*Table 5*). At Blackhammer, Calf of Eday and Huntersquoy single finds of axes were found in the clay floor of the chamber and in the case of Huntersquoy the axe was found in the prepared clay floor of the upper chamber (Callander & Grant 1937; Calder 1938). The axe from Knowe of Laird was placed on the floor at the entrance to one of the compartments (Grant & Wilson 1943). The two axes from Calf of Eday Long cairn were placed together on a bench or shelf inside one of the compartments of the tomb (Calder 1937). The axes from these tombs vary in shape and size but all have a rounded cross-section formed by narrow linear facets ground down the sides. They are all made from grey rock either volcanic or possibly sandstone and two (BL/RO.1 and HU/ED.1) feature pockets of crystalline inclusions.

At Howe two axes were placed on the clay layer that was made over the levelled remains of a structure that could be interpreted as either an Orkney Cromarty tomb or Early Neolithic house type. This layer was then succeeded by a Maes Howe type tomb (Ballin Smith 1994). Both axes (HO/STR.1, HO/STR.2) were made of a similar green igneous rock but were different in size and shape.

The axes mentioned above can all be dated to the use or abandonment of Orkney Cromarty tombs. However, at Isbister a group of three axes were found together with a jet button, a macehead and a ground knife on the plinth of the revetment wall to the N of the cairn. It was suggested by Roy Ritchie that these artefacts were placed together in a bag secured by the jet button (Hedges 1983:45). The three axes included one of haematite (IS/SR.1) which has special physical properties (see above) and two of similar green stone, most likely derived from igneous source (IS/SR.2, IS/SR.3). The two complete axes differ in length but they have similar cross-sections and all three have similar thicknesses and have single flat facets ground down the sides. The association of V-bored jet buttons with single grave burials from the Bronze Age (*ibid*) would suggest that these axes were cached in the Early Bronze Age well after the original use of the chambered tomb for collective burial. There is no direct evidence to link these axes directly with funerary ritual though it is interesting to note that human bone dated to the middle of the 2nd millennium BC was found in a gap in the retaining wall built later around the back

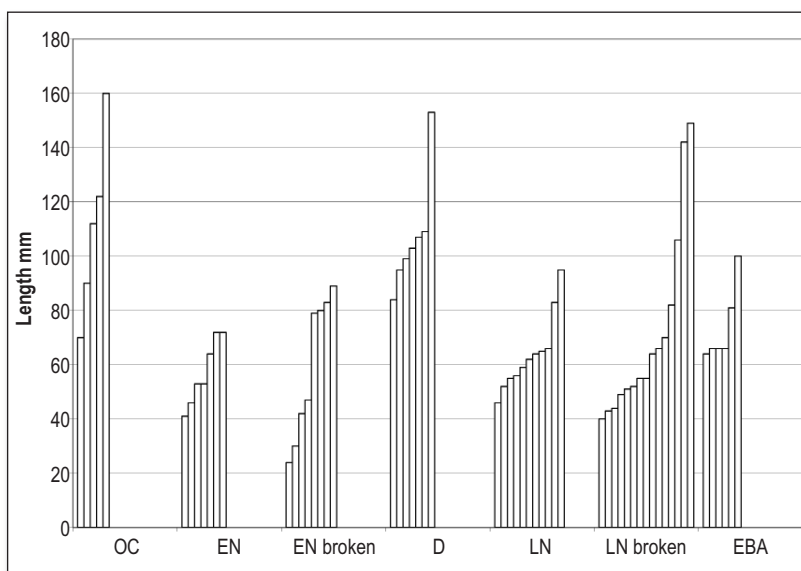
of the tomb constituting a form of burial rite in the Early Bronze Age.

There are two axes that appear to be directly associated with funerary contexts from the Early Bronze Age and these share the same type of context of deposition (*Table 5*). At both Knowes of Trotty, Harray and Mousland, Stromness an axe was placed outside a cist in the activity area associated with the funerary rituals. The stone selected for these axes differ – that from Mousland (MO/STR.1) is a soft, light coloured rock, possibly chalk or steatite whilst the Knowes of Trotty axe (KT/HA.1) is a fine-grained but harder grey stone. They are closely similar in size and shape apart from the finer shaping of the almost pointed butt on the Mousland axe and the faceted sides on the Knowes of Trotty axe.

Fig. 9.
Axe length by
context type.
OC:
Orkney Cromarty tombs;
EN:
Early Neolithic
occupation;
EN broken:
axe fragments;
D:
deliberate deposits
in structures;
LN:
Late Neolithic;
EBA:
Early Bronze Age
middens and funerary
associations.

Does size matter?

It would appear that the size of an axe did indeed matter – but this was dependent on what it was used for. Axes that were placed in chambered tombs or as special deposits at occupation sites are clearly larger than axes that were in general use on settlement sites (*Fig. 9*) and not only were these axes large but they were more likely to be complete. The axes from the Late Neolithic houses were often further defined by their shape e.g. chisel axes or at least more elongated forms, and by their choice of stone e.g. speckled stone, quartz, crystalline etc. In contrast, axes that were deposited in the Orkney Cromarty tombs were as large as those above (*Fig. 9*) but had less variation in shape and were possibly more restricted in the choice of stone.



The axes from external deposits at settlement sites were in general smaller in size or more fragmented than the above. At first glance there does not appear to be a great difference in size between the complete axes from Early Neolithic and Late Neolithic settlement sites but the broken fragments, some of which are larger than whole axes suggest that the size range of the axes, when originally made, was wider than the graph of the complete axes would suggest and this is true for axes from both Early and Late Neolithic sites (Fig. 9). Were the larger axes more vulnerable to breakage or were they deliberately broken and the smaller ones left whole? It is interesting that the four largest broken axe fragments are from Barnhouse and that their lengths are well within in the size range for the complete axes found in deliberate deposits (Fig. 9, Photo 6). Perhaps these axes were broken as part of some ritual activity and the fragments then placed outside the structures. A flake from a polished stone axe found in Structure 8 at Barnhouse (Table 6) may also hint at the use of axes inside the structures.

Why were they put there?

It has been assumed throughout this paper that some of the contexts in which axes have been found could be interpreted on a non-utilitarian level; that significance was attached to their deliberately being placed inside Early Neolithic chambered tombs and Late Neolithic structures. In most cases the axes were associated with floors, often being placed away from the day-to-day traffic in the house either in recesses (Barnhouse, Crossiecrown, and Skara Brae) or at least against a wall (Tofts Ness). At Stonehall the axe was hidden under the floor in a cist. These contexts suggest that the axes were in position in the houses whilst the houses were in use. In contrast the chisel axe at Skara Brae was discovered with a group of other interesting and decorative artefacts that were interpreted by the excavator as a closing deposit (Clarke 1976) presumably placed there after the house had ceased to be inhabited. These deposits are like snapshots; they are frozen moments in time that give the impression of a highly structured or controlled environment. At Barnhouse the large axe fragments deposited outside the structures and an axe flake inside suggest that axes also had a more active role and that they were used or broken as part of the ritual.

Axes were often placed on floors in Orkney Cromarty tombs and at Calf of Eday Long two axes were found on a bench. It is not known



Photo 6.
Broken axes from
Barnhouse, Stenness.

just how these related to the funerary rites of the tombs, whether they too could be interpreted as closing deposits or whether they are representative in some way of the people left behind. At Howe the two axes were very deliberately placed in clay that sealed an Early Neolithic tomb (or house) prior to it being built upon by a Late Neolithic type tomb. In this case the axes could be seen as markers of transition or change.

The continued use of stone axes into the Early Bronze Age is marked by their occurrence at cist cemeteries as well as in middens of this date at settlement sites.

On a broader scale the use of axes can be seen to vary between funerary and settlement contexts of the Early and Late Neolithic. At the Early Neolithic settlements of Wideford Hill and Braes of Ha'Breck the axes are, as well as being amongst the smallest axes, often broken, they exhibit fine shaping by facets on the butts and/or sides, and they are made of fine-grained sedimentary rocks. In contrast the axes from the Early Neolithic tombs are larger, more often with a rounded cross-section and several are made from igneous rock. This dichotomy in the size and shape of axes between settlements and tombs in the Early Neolithic is echoed by the lack of what could be considered as domestic tools at tombs; none of the coarse stone tools so common at settlement sites have been found at Early Neolithic tombs (Clarke 2006). In contrast coarse stone tools are present at some Late Neolithic Maes Howe type tombs (ibid) and perhaps significantly there are no axes from these funerary contexts. Instead axes are found at settlement sites where they are often used in day-to-day ritual of living.

Conclusion

Axes clearly reflect life as it was lived in Neolithic Orkney; they are present in contexts of both the living and the dead as well as in the worlds between. Whether future excavation will enhance or contradict the present narrative is another story waiting to be told; hopefully their contextual significance has now been recognised.

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■ ■ ■ A *Cumbrian* style roughout of epidotised tuff, on loan to the Tullie House Museum in Carlisle, Cumbria. The surface of the blade has been heavily etched and coloured by chemical erosion, a function of the acidity of the soil in which it lay until its discovery. A recent break on the cutting edge reveals the true grey green of the stone within. The form of the roughout anticipates that seen in many finished *Cumbrian* blades. Even before grinding, the elongated form, waisted butt and diminutive cutting edge are apparent. The blade departs from common symmetries towards the butt, a sharper angle on one side exaggerated by a more recent break. Technically, the roughout remains unfinished. But there is, on one face at least, a small area where the ridges and scars of flaking have been ground more or less flat. In the middle of the blade, near the point of maximum thickness, a small area of grey green stone bears witness to the use of the blade as a doorstop for the last few decades. ■

Photo:
Tullie House Museum, Carlisle



●●● *It was his idea. He wanted the collection catalogued because he didn't want it forgotten. We went round and the outbuilding was stuffed with axes. Most were off his land though he'd picked up a few elsewhere along the way. We did quick shots of the display but nothing was labelled, so we agreed to come back and commit his memory to record. When we heard that he'd died the project kind of came to a halt. ●*

Neolithic ground axe-heads and monuments in Wessex

Abstract

While central southern England is well known for its extant Neolithic monuments and for the fine artefacts recovered from some of its Bronze Age barrows, Neolithic artefacts from the region have received relatively little attention. This might be considered surprising, as the area not only witnessed some of the earliest investigations into the source of materials, notably the Stonehenge bluestones, but it also harbours some of the earliest dated ground axes in the country. This article examines the occurrence and distribution of ground axes found in Wessex when compared to other artefact types. More importantly, comparison with the location of extant monuments allows a rather different view of Wessex to emerge. The article will consider the influence of local resources, of flint mines such as those at Durrington, Easton Down and Porton Down in Wiltshire, and the extent and processes by which axes of non-local materials may have been introduced and dispersed across the landscape.

Flint is indigenous to Wessex; ubiquitous, both in its nodular form obtained directly from the chalk and as secondary material found in solifluction deposits or river gravels. It is easily obtained, particularly where river valleys cut through chalk deposits or where seams break out on the surface. For millennia prior to the Neolithic it had been widely utilised and there is much evidence of the material (or at least tools made from it) being carried good distances. The raw material for flint tools found in the Mendip caves, for example, must have come from the Wiltshire Downs and presence there indicates that the chalk played its part in procurement strategies quite early in the post-glacial period, while Upper Palaeolithic sites at Hengistbury Head also used this material and paths trodden and patterns of movement established during the earlier Holocene may have become traditional by the early Neolithic. Alan Saville (1982) estimated that during the Neolithic over 1000 nodules per year were leaving the Wessex downs for Gloucestershire alone.

Consider, for example, the plot of tranche axe-heads, most of which are likely to be Mesolithic in date (Field 2008:27). Although a broad scatter occurs on the chalk, there is a tendency for them to concentrate in the river valleys, notably the Avon and its tributaries, but there is also a particular emphasis on the coastal plain. It is evident that the chalk with its major resource of natural flint is no more favoured for settlement than anywhere else. The picture, however, is only partial as the coastline lay much further to the south during the earlier part of the Holocene and sites found along the present shore will have originally lay a good distance inland. Given the underwater work off of Bouldnor Cliff on the Isle of Wight by Garry Momber (2000) that has revealed Mesolithic material, along with accounts of other finds dredged up from around the coast (e.g. Verhart 1995), it might be fair to expect the sort of recovery rate experienced on the present coastal plain to be found right across the more extensive terrain particularly close to former shorelines. While river and beach flint was available in these areas, depending on location, a journey of 40km or more might be necessary to obtain good quality natural flint nodules from the chalk.

A blue-grey siliceous material known as Portland Chert after its major source was a good substitute, which was available from close to the coastal plain at Portland Bill (Palmer 1999), and its aesthetic qualities resulted in it being carried along the coast and inland reaching as

far as Surrey in the Weald. The largest accumulation however, lies around what is now the mouth of the River Avon in precisely the same location as the greatest cluster of tranche axe-heads. By the 5th millennium and probably before, materials were therefore reaching the area around Bournemouth and Christchurch from at least two separate locations. While flint may have arrived from inland via the River Avon, Portland Chert *could* have arrived by sea.

The jadeite axe-head found alongside the River Avon at Breamore, Hampshire, *must* have arrived by sea as there is no known source of this material in the British Isles. It is a long slender axe-head, the type formerly described by Alan Woolley and others as the 'torpedo' type: a form often depicted on the tombs around Carnac in Brittany. Until recently its age was estimated by comparison with another jadeite found beneath the Sweet Track in Somerset and dated by dendrochronology to 3806BC, but the work of Pierre Petrequin and colleagues on jadeites has changed that (Petrequin *et al.* 2006). Petrequin suggests that it is an unusual type, but found in association with long tumuli in Brittany between 4500 and 4300 and not used after that date (pers comm.). Either it was brought to the British Isles hundreds of years later as an heirloom or symbolic relic, or ground axe-heads were in use in Britain much earlier than imagined (Sheridan *et al.* 2010). There are just a few indications that the latter could be the case. A number of flint mines in Sussex have pre-monument horizon C14 dates of around 4000cal BC and those are from shafts that appear to represent a mature stage of the sites development, while a single date of 4230–4190 or 4150–3780 for one of the pits at Martin's Clump also hints at an earlier genesis (Barber *et al.* 1999). An early date of 4350–3990cal BC has recently come from a flake scatter of Group VII material beneath a cairn at Graiglwyd (Williams & Davidson 1998:19; Williams pers comm). Some support for these dates is provided by the recovery of a ground flint axe-head butt along with carinated bowl pottery in a well dated deposit at Down Farm, Sixpenny Handley. At 4250–3980cal BC (Green 2000:pers comm.; but c.f. French *et al.* 2007 for a note of caution) this is the earliest dated ground flint axe-head in Britain and, made of indigenous material, its presence implies that the technique of grinding flint came to these shores well before that date. In contrast, there are similarly few hints that items may have been curated for long periods. The, probably cattle, long bone recovered from stone hole 27 of the sarsen circle at Stonehenge produced a

C14 date of 4360–3990calBC (OxA-4902), while two mandibles and a cattle skull placed on the ditch floor may also have been curated and kept in circulation before being deliberately placed there (Serjeantson in Cleal *et al.* 1995:442, 449). The identity of artefacts is sometimes discussed in the literature (e.g. Edmonds 1998:263–5), but this serves to emphasise that some pieces could have had very lengthy biographies indeed.

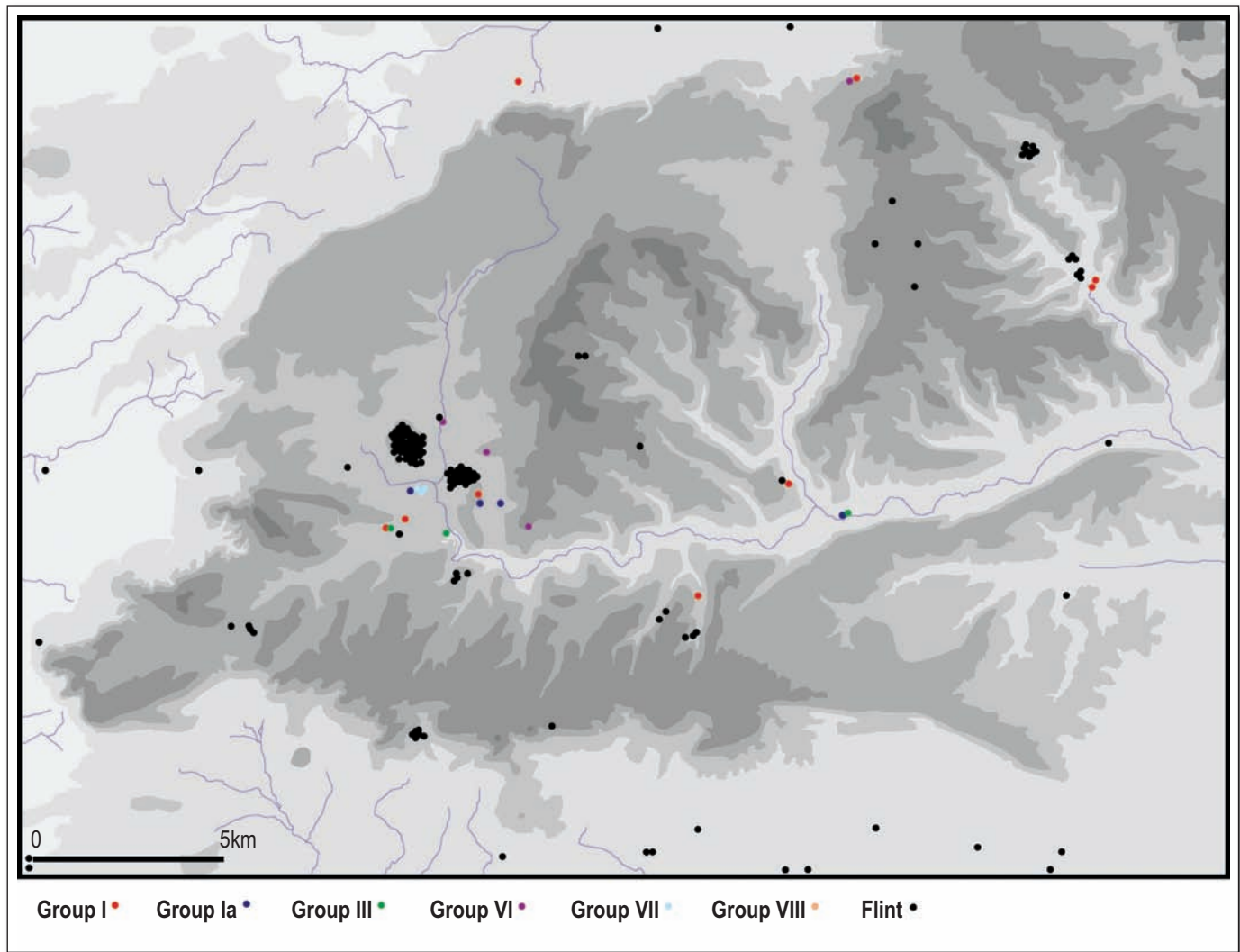
The impact of the introduction of the Breamore jadeite must have been enormous. Aesthetically perfect and of an unusual translucent pale green colour, despite its slender profile it had enormous strength and the inhabitants of Wessex will have seen nothing quite like it. The biography of the piece, however, may have been of even greater importance, it having been carried from a distant land where, in turn, it may have been thought to have had mythical and potentially supernatural origins. Petrequin and colleagues have analysed this axe-head and confirmed that it made from jadeite originating on Monte Beigna, north of Genoa, an area of snow capped mountains of immense grandeur and far greater height than anything that Salisbury Plain had to offer. Mimicry might be expected. Yvan Pailler has searched for copies of the form and found them (pers comm.). Since Reginald Smith's analysis in 1921, pointed butt ground axe-heads have been considered an early form, although with an origin in Scandinavia rather than further south in Europe. It is noteworthy that the flint axe-head from the Down Farm shaft has a pointed butt. This is not to suggest that all pointed butt axe-heads had the same origins and date, simply that there was a mental template available. Other jadeites of different form arrived along the south coast as did axe-heads from a mountain, Teivebulliagh, in Northern Ireland and given the distribution pattern appear to have been moved inland along the river systems. The mouth of the River Avon is thus likely to have become an important locale in the transmission of both materials and ideas.

Axe-heads from Wessex were among the first to be analysed petrologically. The sub-committee of the south western museums association was established in 1936 and Alexander Keiller, Stuart Piggott and F S Wallis produced a series of distribution maps depicting the location of artefacts made of rock from other parts of Britain and which they were able to 'group' together as rock types (Keiller *et al.* 1941). Those of rock Group VI, then thought to derive from the Stake Pass area of Cumbria, were seen to form a concentration in north Wiltshire around Windmill Hill and Avebury. However, more

recent analysis of similar artefacts elsewhere in Wessex demonstrates a slightly different distribution and there are in fact as many on the coastal plain as further inland. Similar distribution patterns occur for axe-heads made of rock from Cornwall and Wales, but it is the flint axe-heads that really demonstrate the favoured locales. Christchurch at the mouth of the River Avon is again important and there is also a group along the spring line in Cranborne Chase as well as on the Greensand around Tisbury, not to mention a massive accumulation around Basingstoke. These contrast markedly with the location of contemporary monuments, long barrows and causewayed enclosures that are located around the fringe of the chalk. Also quite noticeable, particularly given the amount of fieldwork in the vicinity, is the comparative lack of stone axe finds around Stonehenge, often thought of as a crucial component of Wessex.

A total of 1175 ground axe-heads of flint have been recorded from the region, many of them broken or found in fragmentary condition and over 400 pecked and/or ground axe-heads made of rocks other than flint. The greater number of these is of surface finds. Of rocks grouped by the Implement Petrology Committee, few provide certain evidence of archaeological activity in the 4th millennium. Axe-heads of Group VI rock from Cumbria were found in primary levels at Windmill Hill and Group VIII from south Wales was also possibly primary. In addition, there are fourth millennium dates for Group XVII axeheads at Maiden Castle. Aside from those at Windmill Hill only six other axe-heads of Group VIII rock are present, two of which came from a later context at the Wyke Down henge: the others divided equally between Coastal Plain and Chalk downland locations. Again coastal positions are well represented amongst Group VI, with a focus in the Bournemouth region, but they are also present along the chalk downland spring line. The intensity of archaeological investigations on the chalk may account for many of the downland finds and without them the contrast is likely to be greater.

The North Wiltshire Downs provide some contrast to Salisbury Plain. Depicted (*Fig 1*) is the watershed of the River Kennet a tributary of the Thames, but it is also the source of other Thames tributaries as well as others of the Bristol Avon. Nevertheless axe-heads of all groups can be seen nestling along watercourses. There is one cluster in the north east around Aldbourne (material in Devizes Museum), but the major accumulation is on the



southern slopes of Windmill Hill near Avebury, adjacent to the well-known causewayed enclosure (material in Avebury and Devizes Museums). Here an enormous number of stone axe-heads have been recovered, most of them broken or fragmentary, 14 of which were amongst the first analysed by Wallis for the Implement Petrology Committee. A massive number of flint axe-heads accompany them from the same slopes, while large numbers have also come from excavations in the causewayed enclosure ditches on top of the hill (Smith 1965:100–103; Whittle *et al.* 1999:318–337). Finds of other types of flint tool from the slopes are equally impressive, notably arrowheads – leaf, petit tranche and barbed and tanged are all present, which numerically reach several hundred and match the large numbers found at Christchurch (Gardiner 1987) and around Basingstoke. This seems to point to similar activities taking place on these slopes over a very long period of time, even after new monuments at Avebury and West Kennet might be expected to have distracted attention.

Most of the material from the enclosure itself came from the upper levels of the ditches, only two pieces being in a primary context, fragments of Groups VI and XI material and possibly a piece of Group VIII rock (Smith 1965: 110–124; Whittle *et al.* 1999:338–341). Otherwise Groups I, IIa, VI, VII, VIII, XI, and XII are all being represented although Groups VI and VIII have the greatest presence. All of the ditches contained some material but the greatest intensity was in the Middle Ditch from where 12 pieces were recovered. What this means in terms of dating is best left until the results of the new dating programme by Alex Bayliss, Alasdair Whittle and Francis Healy are announced, but broadly we can expect Groups VI and XI rock to have arrived in Wiltshire by the second quarter of the 4th millennium.

Being situated on Middle Chalk, Windmill Hill is not a flint source and the nearest fresh flint is several kms away. It is of no surprise that flint artefacts and waste are relatively small, even broken axe-heads being reused as cores and scrapers. In fact almost all of the axe-heads

Fig. 1.

The area around the head of the River Kennet in North Wiltshire showing the distribution of broken and complete axe-heads finds plotted against the drainage pattern.

The great accumulations in the west centre of the map are those on the slopes around Windmill Hill and Avebury.

Background illustration by Deborah Cunliffe.

are broken or fragmentary and consequently it is difficult to be absolutely certain of form, although it is possible to make out at least ten with faceted sides. Isobel Smith felt that, because of the high quality of the flint, like the stone axe-heads, the flint axes had been almost entirely imported as finished tools. Certainly the pearl grey material stands out visually as distinct from local material and seven fragments from the 1988 excavations were described by Josh Pollard as being 'creamier' in colour than the rest of the assemblage. Six flint axe-head fragments came from primary levels, though it was thought that many of those in such positions also derived from earlier occupation. Josh Pollard analysed them and found that 28 derived from the inner ditch, 31 from the middle ditch and 12 from the outer a distribution similar to that of stone axe-heads (Pollard in Whittle *et al.* 1999). The remarkable point about these axe-heads is that in contrast to those deposited in rivers, they are broken and fragmented and unless breakage was deliberate, might be taken to indicate utilitarian use on the site rather than ritual activity. Equally Pollard has pointed out that they were not being passed onwards and so the enclosure did not appear to have a marketing function in terms of axe-head redistribution.

Elsewhere in Wessex there are few firm associations. Other causewayed enclosures at Knap Hill, Robin Hoods Ball, Rybury and White Sheet Hill are devoid of ground axe-heads, though numbers occur at both Maiden Castle and Hambledon Hill. From Hambledon Hill, a jadeite and nephrite and at least 21 broken axe-heads and flakes have been recorded including material from Groups I, IV, VI, VII, XVI and XVII as well as three complete flint axe-heads from an excavation by Desmond Bonney that are now unfortunately lost. Material from the excavations at Hambledon is now published (Mercer & Healy 2009, but it may be that the site performed a similar role to Windmill Hill and fieldwalking on the flanks may reveal similar quantities of material. Fewer pieces were recovered from Maiden Castle. Just eight ground flint axe-heads were found in fieldwalking mostly to the north of the causewayed enclosure, while Wheeler's excavation (Wheeler 1943) produced six broken and fragmentary ground flint axe-heads along with fourteen stone axe-heads of which four were of Group IVa. More recent excavations by Niall Sharples (1991) revealed a further two stone axe-heads again of Group IVa rock, only one of which was complete.

No axe-heads have been recovered from long barrows with the possible exception of

King Barrow in Wiltshire, where a fragment of purple stone illustrated by Philip Crocker (Crocker mss Devizes Museum) was amongst the finds recorded by William Cunnington (Eagles & Field 2004) and there is an axe-head from the Roman levels of Wor Barrow ditch excavated by General Pitt Rivers (1898). Two ungrouped greenstone axe-heads were also found in the bank barrow matrix at Maiden Castle (Wheeler 1943:164–6).

Aside from the flint axe-head butt from the Fir Tree Field shaft already mentioned, the earliest dated axe-head in the region is from a pit known as the Anomaly on Coneybury Hill overlooking both the Avon Valley and Stonehenge Bottom. Only the butt was placed in the pit along with plain and carinated bowl pottery and cattle, deer, pig and beaver bone. It is of a type that appears to have come from a flint mine rather than being made of the local material and has a C14 date of 4040–3640 at 2 sig or 3980–3708 1sig (Richards 1990).

Excavations at Durrington Walls revealed a complete ground flint axe-head with lenticular cross-section recovered from *beneath* the bank, along with leaf arrowhead, scrapers and plain bowl pottery (Wainwright 1971), while an axe-head was found in a similar position at Mount Pleasant (Wainwright 1979). Numbers of ground flint axe-heads have been found in the fields around the Avebury henge, but as at Durrington there is little to link them with the monument itself, and there is consequently little evidence of the henges having played a major role in distribution.

There continued to be a symbolic fascination, however. It may be worth mentioning the two small chalk axe-heads with pointed butt and triangular shape almost certainly made for immediate burial from Hole A16 at Woodhenge and a fragment of another from Stonehenge. At Upton Lovell G2a, 2 skeletons were found in pit beneath a shallow barrow, one lying on its back and the other in a sitting position. At the feet of the prone skeleton was a group of over 36 sharpened and perforated bones along with 3 pointed butt and partly reflaked ground flint axe-heads (Hoare 1812:75–77). The larger skeleton had a battle axe-head at the chest and with these items were a broken shale or jet ring and a dished stone now thought to have been involved in gold working. Whether interpreted as the burial of a shaman or goldsmith it suggests that ground axe-heads were still being used for certain special or ceremonial purposes at the beginning of the metal age. A specimen of *bos primigenius* found in peat at Burwell Fen, Cambridgeshire with an edge ground axe-head

embedded in its forehead (Babbington 1864) and a C14 date in the 3rd millennium and might be the kind of activity ritually undertaken.

Despite the presence of metal, use of ground axe-heads continued well into the Bronze Age and a series of finds of fragments in round barrows, Woodlands G5, Hurn G1, Wimborne St Giles G9, and Collingbourne Kingston G6 may be residual, or remnants of once treasured and curated heirlooms (McK Clough & Cummins 1988).

Whether the early flint mine at Martins Clump on Porton Down had ancestral origins in the Mesolithic is unknown at present. In contrast to the Sussex sites the land here is not particularly high or awe inspiring, but it lies at the head of a bowl or natural amphitheatre where flint is relatively close to the surface. Its location, situated within a secret research establishment, has resulted in limited archaeological investigation, but enough has been done to determine that it differs from other flint mines in the south of England. The small pits are discreet and widely spaced and the site did not develop the monumentality that others did and construction of a long barrow on the fringe of the site might conceivably have announced the end of extraction.

The mine on Easton Down is rather different. Location around the upper end of a narrow coombe is unusual, the shafts are larger in scale, but there are fewer of them and they are irregularly spaced. Indeed, of the six shafts excavated by J F S Stone in the 1930s, only two encountered a flint seam and one of those continued down evidently in search of a better product. The others were abandoned at relatively shallow depths. This is curious given that flint must have outcropped around the coombe sides and so was easily traced. The seams may even have acted as a perched water table and provided a potential spring line in wet weather. With so many abortive shafts it may be worth considering whether flint was in fact the prime objective or whether it was water or perhaps the chalk itself (?for paint). Discussion in recent years has highlighted the Neolithic interest in cavities in the ground. A 7m deep shaft was excavated through a curious sunken barrow floor at the centre of a pit circle at Monkton up Wimborne on Cranborne Chase (French *et al.* 2007; Green 2000). A thin flint seam at the base was unusable but would have held back water and the excavator suggested (pers comm.) that white body paint may have held a certain symbolic value. Similarly an estimated 45 shafts reaching over 6m in depth were cut into the

base of the henge ditch at Maumbury Rings with placed deposits of carved chalk, bone and pot fragments at the base (Bradley 1976). It has been suggested that the shafts at Eaton Heath in Norfolk may be sink holes (Healy 1986:57–8). Nevertheless, in the Mendips, a landscape of natural sink holes, some at least were entered in the Neolithic (Lewis 2005), while Ann Woodward (2000) has drawn attention to barrow cemeteries in association with sink holes at Poor Lot, Bronkham Hill and Bryants Puddle Heath in Dorset, where such natural features are considered to be an integral component of the barrow cemeteries by Chris Tilley. Jodie Lewis (2005) has described Neolithic material, including grooved ware fragments, found placed at various depths in Mendips examples and, crucially from our point of view, a complete ground and polished greenstone axe-head with pointed butt and triangular form, apparently in imitation of a jadeite, placed in a niche some 10m below the surface. Others have described the common links between these kinds of sites, caves, fissures as an interface with a supernatural domain and there is little point pursuing the matter here, but worth noting that similar perceptions and mythologies applied to flint mines have also been described.

None of the Wessex flint mines appear to have developed in the same way as those in Sussex and, in contrast to Martins Clump, based on the excavated artefacts and a single C14 date, both Durrington and Easton Down are thought to be relatively late complexes, although there is some uncertainty about Easton Down (Barber *et al.* 1999). Given the small nature of the pits at Martin's Clump, and the abortive pits at Easton Down, whether the bulk of the Wessex axe-heads came from these sites seems rather unlikely and a remaining option is that flint axe-heads were being transported from the huge Sussex mines. Interestingly, this would accord with the trace element analysis carried out by Paul Craddock and colleagues at the British Museum in 1983. In that analysis, axe-heads from Windmill Hill were compared with surface flint from nearby and found to have a different signature, but instead one that compared closely with that of Sussex mines (Craddock *et al.* 1983). Of course there were problems inherent in this, not least the restrictions noted by the authors, but it is nevertheless interesting that over 50% of Wessex axe-heads were considered by them to come from Sussex. Despite the ubiquity of flint in Wessex there continues to be something distinctive and curious about ground axe-heads and their source material that adds to the

inventory of ridiculously long axe-heads depicted on Carnac tombs, to the enormous numbers ritually thrown into the River Thames at London, and evidently dropped onto inaccessible submerged landscapes at the Dogger Bank (McK Clough & Cummins 1988:216; IPC Yorkshire Nos 700 and 701 Skipton Museum Accession Nos A 38 a and b), or indeed the Brown Bank (Jan Glimmerveen pers comm.), which must have been 10m below water at the time that it was deposited. It may be that further investigation of the river margins in Wessex and the submerged landscape off the south coast may bring to light similar material.

Conclusion

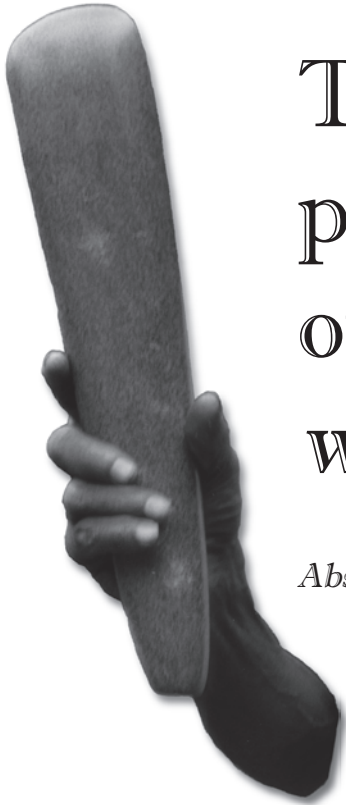
While the distribution of flint and stone axe-heads in Wessex is mirrored in other tool types, aside from the exceptional cases of the three major enclosures, Windmill Hill, Maiden Castle and Hambledon Hill, it contrasts quite markedly with that of the well-known monuments. Rather than inland around Stonehenge, the epi-centre of activity is at the mouth of the River Avon, from where axe-heads of non-local stone may have been introduced and dispersed, while there are other important concentrations of activity around Tisbury and Basingstoke. In the search for explanations the monument concentration on the chalk of Wiltshire can be seen to be a product of medieval and post medieval land-use that has produced a biased survival record. This reveals some exciting prospects. It is evident that the search for settlement, at least in part, has been misdirected and there are now some interesting new locales to investigate.

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The twentieth-century polished stone axeheads of New Guinea: *why study them?*

Abstract

At a time in the history of archaeological research when the use of ethnographic analogy in its strict sense is out of fashion, the ethnographic examples from present-day New Guinea have considerable importance for archaeological theory in helping us to understand, from living people, what a polished stone axehead might represent.

In using the results of their 21 years of fieldwork in New Guinea, the authors set forth a panorama of different social interpretations of polished stone axeheads, showing how a tool ostensibly for clearing the forest could be used for other, non-utilitarian purposes, and not just in the sphere of commerce: for the accumulation of wealth, for marriage and death payments, for demonstrating the status of important men, for gift exchange and for rituals connected with communicating with the spirit world. Thus, the people who manufacture these axeheads are regarded above all as powerful ritual specialists, allowed to work with raw materials that were formed at the beginning of the world by Primordial Beings. It is this social and religious significance that lends axeheads their special value, as objects that participate in the material and ideological reproduction of these communities of forest farmers.

Such modern ethnographic examples encourage us to reconsider the status and significance of Neolithic polished stone tools, and offer us powerful models to test against the remains of the past.

Introduction

Current scientific studies of Neolithic polished stone axeheads and adze-heads are orientated in several directions, but are rarely led from the front. The first of these directions, it would appear, is that taken by mineralogists who concern themselves with determining the rock types from which these blades had been made. They often use a wide range of analytical techniques and equipment, as employed in geology and petrology. The aim is to pinpoint the places where the rocks had been extracted, and to reconstruct the theoretically straight-line movements taken by the raw material and artifacts from the source areas to the farthest-flung users. Within this specialism, which comes from the world of natural sciences and tends to ignore the social aspects of life, issues of chronology and the typological classification of polished stone industries are given little consideration. Instead, it is assumed that some kind of unchanging set of modalities of extraction, manufacture, circulation and use of axeheads had existed over long periods during the Neolithic: no evolution is envisaged, even over several millennia.

A second orientation – in the sense of the word that we are using here – privileges the functional aspects of stone tools. This perspective characterizes the work of prehistorians whose research focuses on technical aspects, on the comparative efficiency of tools made from different raw materials. Their work, like that of the mineralogists, concerns itself with the conditions of extraction, with the techniques used to manufacture axes (flaking, pecking, sawing and hafting), and with studying use-wear traces. This approach concentrates on recording diagnostic features relating to manufacture and use, and on reconstructing the *chaîne opératoire*, in order to assess the techniques of manufacture and the skill of the stone axehead maker. The chronological and social aspects of the production, exchange and use of axeheads usually occupy the hinterland of such research, or are even sometimes considered to be inaccessible to the prehistorian. One could characterize this axis of research as being based on an ‘engineering science’ perspective.

Typologists tend to follow a third path, focusing on the classification of forms, on chronology, and on the spatial relationships with artefactual assemblages belonging to specific archaeological cultures – cultures that are in a constant state of evolution, changing more or less rapidly. The accent, then, is on instability, on permanent adjustment to change, and on

the transformation of material culture assemblages according to complex social processes whose understanding lies in the realm of the social sciences. As with all other kinds of artifacts, then, polished stone tools are regarded as a sign, to be described and interpreted as a marker of particular social phenomena.

One could argue, of course, that these different approaches ought to be complementary, covering all the different facets offered by a polished stone axehead. In effect, it is difficult to see how one could knowingly exclude one or other of these points of view, or privilege one to the detriment of the others, even if we accept that archaeological research tends to be conducted within narrow specialisms, given the complexity of the scientific methods of analysis that are involved. But the history of research shows us that truly interdisciplinary work remains the exception rather than the rule (despite there being a shared vocabulary of terms): what we see is specialists who each defend their very different points of view and often do not want to consider the others’.

One feature that is common to all these specialist perspectives is the relative weakness of interpretative hypotheses about the past. People write about the modalities of axehead production, but do not address the questions of who did the manufacture, and where, how and why it was done. They write about long-distance transfers (How? To what end? Why?); and about the use of stone axeheads (as what? Utilitarian tools? Social symbols? And why should they be used in a particular way?). It is true that researchers have long acknowledged a difference between workaday axeheads, made for chopping down trees and working wood, and the magnificent highly polished examples which are classified as being ‘prestige’, ‘ceremonial’ or ‘ritual’ axeheads – terms which are particularly vague and of very little heuristic value as currently defined. Furthermore, the foundations of this conventional distinction between utilitarian and non-utilitarian are not always clear, and might simply be part of our western preoccupation with defining simple binary oppositions. We tend to avoid confronting more complex systems, as can be seen in our approaches to understanding our own societies: we have difficulty in apprehending the complexities of how societies operate because we are too close to the subject matter, and because the complexities are manifested in banal ways. In other words, we could say that researchers (and we are all researchers) tend to simplify their studies and their interpretations as part of an unconscious projection onto the



past of modern ideas about 'common sense' behaviour: we judge the past against our own contemporary ideals and values. If this is a correct reading of the evidence, it seems that we are dealing with an ethnocentric, one-sided attitude which reduces the quality of research and of reasoning and fails to capture the complexity of different cultures over time. Put differently, our current scientific approaches rest on a narrow comparative ethnography which is informed by the values of our own western societies and dominated by the enduring and politically correct myths of positivism, materialism, technology, science, progress, development *et cetera* (Pétrequin & Pétrequin 1992).

Long after ethnologists had already done so, various theoreticians of the New Archaeology school turned to the study of contemporary ethnographic situations in order to construct predictive models and to test alternative interpretative theories against archaeological evidence in their research into the underlying factors involved in the functioning of agricultural societies. Regarding ground stone axeheads, let us remember the very interesting theoretical developments linked to the study of their spatial distribution, their mode of transfer and their circulation over various distances (among which are the studies of Hodder 1976 and of Renfrew, 1975 and 1977). These theories continue to influence notions of exchange that are used by petrographers and by prehistorians when discussing ground stone 'tools'. Nowadays archaeological model-building has fallen out of favour – especially in those cases where research is undertaken on geographically distant cultures, which can be very different from our own. The reason for this is that all kinds of comparative study – and even the idea that trans-cultural regularities in behaviour could exist – have fallen out of favour among most scientists. This attitude shows that researchers who are reluctant to search for ideas and for theoretical insights (i.e. working hypotheses) in present-day or recent societies have forgotten that the modest theoretical baggage that they bring to the task was itself founded on ethnographic observations. To use hypotheses that are based on observations of contemporary societies is not to say that we should assume that Neolithic societies in Europe operated in a similar way to our own, or to those of other societies thousands of kilometres away, which have followed their own developmental trajectories over time (Pétrequin & Pétrequin 1992).

What interests ethnoarchaeologists above all else is not, in fact, how an axehead or adze-

head is manufactured or used; these aspects can be reconstructed, in a reasonably plausible manner, using classic methods of technology. Rather, it is the *meanings* that Neolithic people accorded to their stone tools, and to each stage in the long sequence of manufacture and use: by focusing on these meanings one can try to understand what it was about a particular type of rock that made people go back and re-use fragments of axeheads that had been thrown out as waste, or to polish a long bar of precious stone to a mirror-like sheen and deposit it vertically in a marsh or at the foot of a stele. While an understanding of the technology of manufacture and use may be indispensable for describing polished stone axeheads, it cannot equip one to comprehend and explain the dynamic of these objects in terms of their *social* role, where the idea that people created themselves through their axeheads is a fundamental concept.

Several examples taken from our 21 ethnoarchaeological missions in New Guinea will serve to illustrate what we mean. We shall seek to show that, in contemporary forest-dwelling horticultural societies, axes and adzes play a central role in the functioning of society. We cannot dissociate technical acts from ritual acts; to do so would be to render incomprehensible the role of socially valorised stone tools (Lemonnier 1986), whose status and biographies are founded on ideal representations of society (Godelier 1996).

Production of polished stone axeheads: factors determining the choice of raw material

Over the last forty years, New Guinea has represented an extraordinary example of where forest-dwelling farmers have still been undertaking their cyclical forest clearance exclusively through the use of axes and adzes with polished stone blades. However, one should add that these communities have not been untouched by the outside world during this time: the first contacts were with gold prospectors, explorers, soldiers and missionaries (Blackwood 1950; Hughes 1977; Le Roux 1950), so that by the time scientific observers arrived, their observations would already have been partly biased by these prior contacts. Among the Baruya, for example, well before the first ethnologists arrived, practically all the men had already adopted steel axeheads, whose use had rapidly diffused inland from the coast (Godelier & Garanger 1973).



The observations that have been made regarding the use of polished stone tools have thus been based on isolated cases, and very often result from the western observers having requested a demonstration. This has been the case among the Una (Fig. 1), who have used steel tools since 1961, and among the Wano in West Papua, who have had them for a similar length of time. Since the first people to contact these communities had other preoccupations than the making of scientific observations, there was a delay of around 20 years before anyone recorded the techniques of tree felling and the modalities of producing stone axeheads. This recording began just as the *savoir-faire* and the traditions were beginning to disappear (Sillitoe 1988). The idea that, in New Guinea, there could still exist isolated groups who had never been aware of steel axeheads is a veritable myth, promoted by the media.

Stone tools were, until recently, at the centre of the physical and technical reproduction of small groups of farmers of the Highlands. These cultivators' gardens of sweet potato, taro and bananas are regularly opened up in the primary or secondary forest, then abandoned after two or three years at most, allowing the forest to regenerate. In other words, the agricultural economy in this area of rapid and universal for-

est regeneration would not be possible without the use of axes and adzes. Despite the unquestionable efficacy of these stone tools, as has been proven through demonstrations of tree felling (Blackwood 1950; Godelier & Garanger 1973; Koch 1984; Pétrequin & Pétrequin 1993). The recent arrival of steel tools – facilitating the opening up of ever larger garden plots – has provoked a veritable intensification of the kinds of social relationship that are based on economic competition (Salisbury 1962).

In these societies, in the midst of change caused by the imposition of peace by the army and by missionaries concerned with salvation of the individual soul, the production of stone axeheads did not cease straight away. This is partly because this production involved large-scale operations to produce axeheads for long-distance distribution, and partly because – as we shall see – axeheads had greater significance than as simple tools for clearing the forest. Thus, between 1960 and 1990, over twenty examples of stone exploitation for axehead manufacture were described, in each case connected with outcrops of hard, tough rocks, whose distribution is very uneven. In addition, various other types of exploitation were documented: mining operations near Mount Hagen (Burton 1984), shafts and mines in the Cyclops

Fig. 1.

Felling of a tree 55 cm in diameter, by four men working in relay over around 90 minutes.

Langda (West Papua, Indonesia), Una group, 1993.



Mountains near Jayapura, quarrying in the Yeleme massif (Fig. 2), and selective collection from screes and from river-torrent deposits immediately below the primary sites in the Highlands of West Papua (Hampton 1999; Pétrequin & Pétrequin 1993; 2006). These various exploitations fed into extensive axehead-exchange networks extending over hundreds of kilometres, and in some cases to the islands lying off the north coast of New Guinea.

As regards the technological aspects of exploitation, the nature of the raw material determines how it is extracted and worked up into roughouts. The toughest rock types, such as glaucophanites, need to be extracted by fire-setting, and shaped using hard hammers or with the aid of an anvil. For fine-grained, non-laminar rocks, such as the andesites and dolerites of the Langda region (Figs. 3 and 4), a complex process of flaking with a hammer is involved. In the case of laminar amphibolites and green schists, exploited by the Dani people, the rocks have to be sawn. At Ormu Wari, with rocks of the serpentinite family, which are coarse-grained, the technique used is pecking (Fig. 7). Finally, the brown and black schists at Tagi (Fig. 5) and the foothills of the Asmat country are worked by direct grinding and polishing (Pétrequin & Pétrequin 1993).

Behind these real technical factors that determine how rock is extracted and worked, there lie variations that are subtle but of great interest. In particular, one could cite the sawing of glaucophane rocks to create exceptionally large polished stone blades, far larger than is strictly needed for the purpose of felling trees. Similarly, with the amphibolites and glaucophanites of the Yeleme massif, one sees different groups of exploiters coming to the same quarries and using different techniques to create roughouts: people of the Wano linguistic group use the technique of hammer and anvil, whereas the Dubele of the Lowlands use pecking and grinding/polishing, and the Dani and Moni saw the rock. Therefore, the technical determinism of the rock itself can be subverted by historically and culturally different groups, all drawn to the sources by their obvious economic wealth, making them veritable 'Axe Mountains'. Technological know-how to work rock evidently plays a considerable role, but is not governed by the desire to maximise production. While most men are, in theory, capable of manufacturing an axehead by sawing or by working on an anvil, it is only those men who are able to do this on a regular basis that become effective axehead producers, utilising complex flaking or hammering procedures

Fig. 2.
Exploitation by fire-setting
at a glaucophane quarry.
Yeleme, Wang-Kob-Me
(West Papua, Indonesia),
Wano group, 1984.

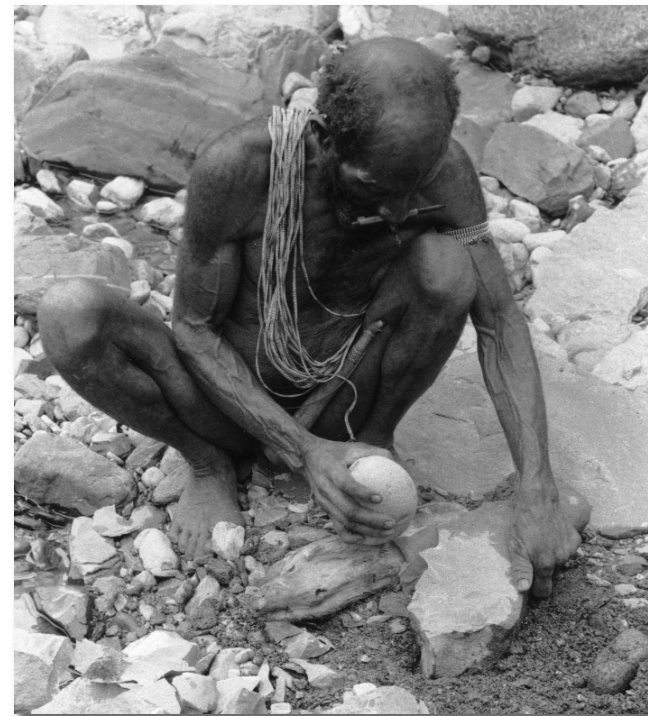
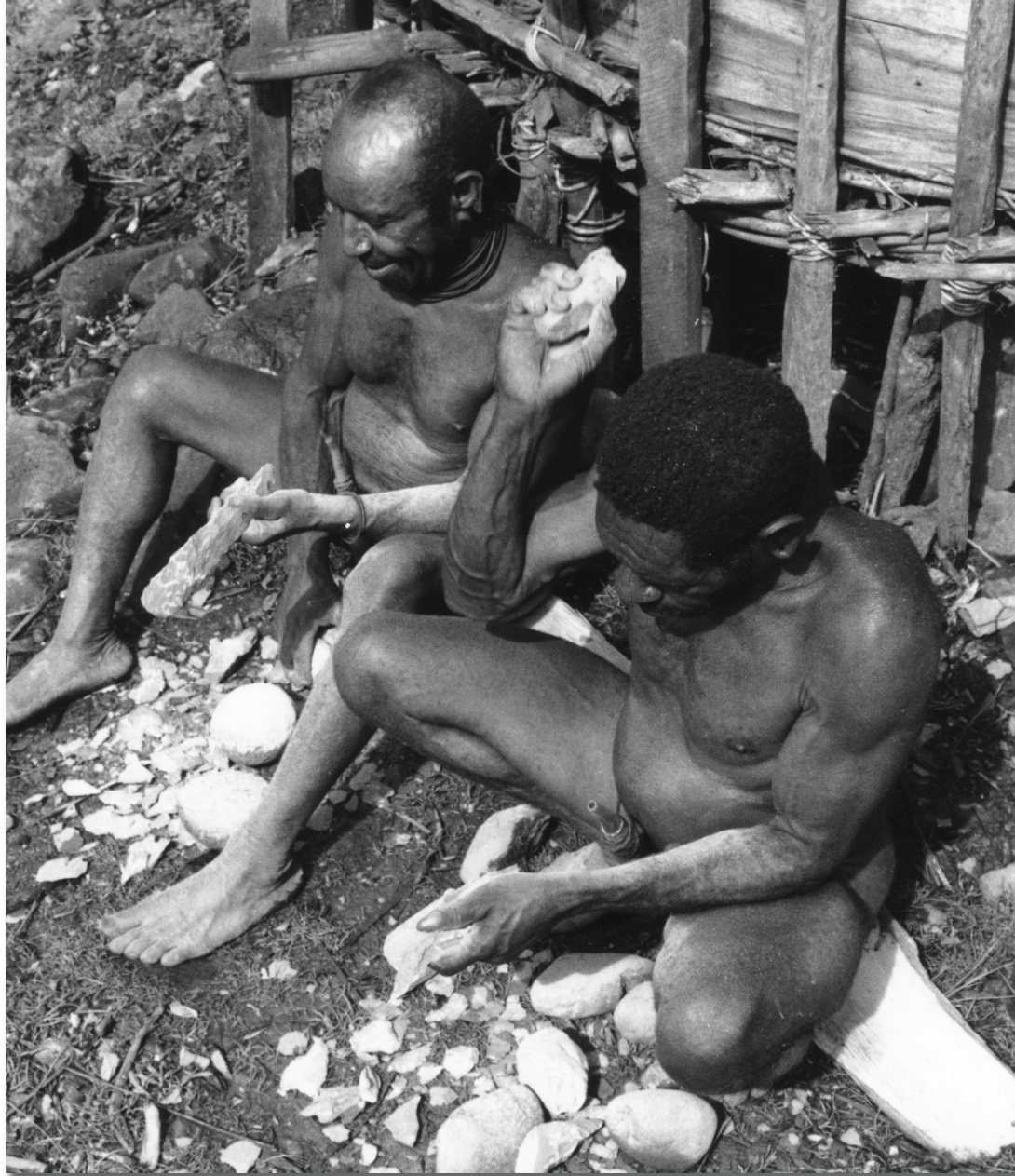


Fig. 3.
Roughing out of a basalt block using a hard hammer,
following extraction by thermal shock. Langda
(West Papua, Indonesia), Una group, 1982.



Fig. 4.

Final shaping of basalt roughouts, by flaking with a soft hammer. Langda (West Papua, Indonesia), Una group, 1993.



which involve an element of risk that is difficult to manage. In inexperienced hands, the use of such techniques could easily lead to roughout breakage.

In virtually all the regions where stone has been exploited, one finds evidence for the various stages involved in the roughing-out of an axehead. At the extraction areas, the evidence is dominated by those stages that involve high risk: fire-setting to extract blocks by thermal shock; initial roughing-out with a heavy hammer; heavy pecking. After this stage the roughed-out blocks are transported down to the permanent settlements and villages, where the final and very time-consuming processes of final pecking, or sawing, take place. Needless to say, there may be variations in this overall scheme: the Wano of Ye-Ineri, who are skilled at flaking stone and who live a day's march away from the quarries, make their very long roughouts of amphibolite schist by the exclu-

sive use of hard-hammer flaking, doing all of this at the quarry. In contrast, the Dani of western New Guinea, who live further from the source – a four or five-day's march – transport large slabs of rock from the source to their settlements, in order to saw them there with the minimum of risk.

One can thus identify regional variations in the ways in which communities that live close to sources of stone extract and work it: there are differences from one quarry to another in the level of skill shown, and this relates to the fact that some groups exploit the rock frequently, others less so. (It should be added that not every community that lives close to a rock source will engage in axehead manufacture; and among the communities that do, not every man will be involved.) As regards identifying individual specialist master axehead makers, famous for their flaking skills, these are only seen among those who exploit tough, fine-





Fig. 5.
Polishing of roughouts
of black schist.
Tagi (West Papua,
Indonesia), Dani group
of North Baliem, 1987.

grained non-laminar rocks, as at Langda, Sela and Suntamon. Here, the production of long adzeheads with D-shaped sections from large, irregularly shaped blocks requires a difficult apprenticeship, reserved for just a few men in each village where such manufacture takes place (Fig. 4). This kind of specialisation is not a full-time activity, however, since the best adzehead makers of Langda also have to cultivate their garden plots and participate in warfare.

The raw material of polished stone axeheads: rituals and social controls

These purely technical aspects, which have been emphasised by ethnoarchaeologists from the beginning of their studies, must however be relativised. When these enquirers posed questions about the techniques and the specialisations (in line with their primary scientific interest), the axehead producers responded in terms of magical practices, rituals and myths,

which formed the foundation of social existence in New Guinea. Thus, we should not imagine that all that was involved in axehead production was men fire-setting, breaking up, flaking, pecking and polishing those simple, particularly hard rocks that constituted the wealth of a region. The raw material being worked was not simply a block of stone. On the contrary: in the realm of social imagery, we are dealing with material that is almost a living entity, relating to the origin of the world, to Dream Time. In effect, the axe- and adzeheads already existed within the rock, because according to myths they are born from the bodies of the Primordial Beings, who offered them, when they died, to the men of knowledge (the manufacturers), by way of intermediaries, the Proprietors of the Land (the ritual specialists). Thus, in the Yeleme massif, the use of thermal shock (Fig. 2) allows people to disengage the axehead roughouts which are fragments of the bones of the Giant which had once been killed, cut up and eaten by the Wano when he emerged from the cave of the origin of the world. According to this concept, it is the power of the ritual specialists



that makes the axeheads emerge from the surface of the quarry. If fire-setting does not work the first time, one rubs the rock with pig fat as a way of invoking the Mother of Axes (Pétrequin & Pétrequin 1993; 2006; Pétrequin *et al.* 2000). Among the Una, several powerful female spirits are similarly invoked so that the Mountain releases its adzehead roughouts. Furthermore, throughout the entire procedure of manufacture, specialists chant and pray to the female spirits so that the roughouts do not break with the blows from the hammer (Louwersee 1998; Pétrequin & Pétrequin 1993; Stuart 2002). The same kinds of rituals as used in axehead production (Burton 1994) have also frequently been recorded as applying to the exploitation of salt (Pétrequin *et al.* 2000) and to sources of clay for making pottery (Pétrequin & Pétrequin 2006). In each case, the idea is the same: people are exploiting a sacred raw material which comes from the body, the humours or the blood of a Dream Time Being, in places that are sometimes secret and often barred to the uninitiated. If an alien human group seeks to exploit these sacred sites, the raw material will dry up and these people will fall ill, because they have not been initiated into the specific rituals for that place.

Contrary to appearances, we are dealing with powerful and effective taboos. At Ormu, on the northern coast of Papua, only the *ondoafi* of the Nari lineage – one of the two traditional hereditary chiefs – can decide the time and place of an expedition to extract rock for making axeheads, after he has spent some time alone on the mountain. In the Yeleme massif, the groups of men who come on expeditions to exploit the quarries call upon Wano specialists who live at the foot of the mountain. At Langda, in common with others in the Una linguistic group, only certain clans have access to the dolerite outcrops, because only they know the myths, the chants and the rituals; furthermore, at Langda the skull of one of these Primordial Beings was kept in a sacred house, along with the hammerstones used to shape roughouts. When one wanted to obtain a particularly long flaked axehead, only a few men would know that it is necessary first to hunt a tree kangaroo and stretch out its intestine along one's left arm (Pétrequin & Pétrequin 1993).

Of course one could smile at these taboos, these myths and these rituals surrounding the production of stone blades. But they form an integral part of a powerful imagery that is accepted by all and that can be found, with minor variations and named differently from one region to another, anchored in collective

practice. In the Sepik valley, it is a group of sacred objects (long natural blades of ringing rock) that forms the basis of control over exploitation of the rock by a single lineage, at Chambri. Elsewhere, it may be a large sacred hammerstone, polished through long use, which allows the opening of a quarry at Ormu. Yet further afield, the axeheads of the Time of the Ancestors were held to be living organisms which fly during the night and which one can attract using pork fat (Pétrequin & Pétrequin 1993). Raw material that is sacred in origin, foundation myths, and secret rites are forms of initiation (and of restrictions) relating to the production of stone blades for axes and adzes. These objects are never simple stone tools.

This is probably one of the reasons why the extraction sites are not visited by individuals on their own. The need for an axehead as a tool or an object for commercial exchange is not sufficient reason to visit the source areas. With the rare exception of manufacture from cobbles selected from riverine deposits, the production of a stone axehead is not a simple act by an individual, to be repeated as the need arises at any time during the year. In contrast, access to these sacred raw materials – which form the power and the wealth of a particular community (in the case of regional specialist producers) – is limited, regulated, and only takes place at certain times.

To gain access to the source areas – which we may think of in terms of extraction sites but which are held to be sacred sites – a group of men set out, accompanied or preceded by a ritual specialist (the Proprietor or Master of the Land, who is in fact the hereditary leader who controls the performance of rituals). Since the quarries are at high altitudes, these expeditions can last several weeks, as in the Yeleme massif where extraction by fire-setting continues until several hundred roughouts have been obtained – the maximum number that can be carried back to the village by each man (sometimes accompanied by his wife). The timing of the expeditions is entirely regulated by social demands, that is to say the regularity of ceremonial exchanges between partner villages, undertaken to pay funerary compensation at the end of a war (blood payments), for the re-establishment of peace, or for new marriage alliances. It was during these festive occasions that the new roughouts were given out in large numbers, and travelled outwards in medium-distance exchanges – a centrifugal movement. Coming in the opposite, centripetal direction towards the centres of production was wealth in the form of pigs or of marine shells and new



wives. These transactions reaffirmed the axe-head producers' alliances and exchange partnerships (Larson 1987; Pétrequin & Pétrequin 1993; 2006).

Ritually-prescribed extraction and shaping, and large scale exchanges or gift-giving: these are what seem to have been the social conditions lying behind the production of stone axe- and adzeheads in New Guinea. This process, from which women are excluded, was not governed by everyday needs for stone blades, but by repeated, collective, long-distance social acts. In these conditions where production was rapid and of short duration, it is not hard to see how the number of roughouts produced was always insufficient for the demand of the users who live at several days' march away from the source areas, or of the other communities who specialised in polishing blades. And this is the probable reason why other rocks, with inferior mechanical properties, were also exploited (in particular schists, chloritites and laminar serpentinites) throughout most of New Guinea, to compensate for the chronic deficit in large and fine stone blades. This secondary production, of 'ersatz' axeheads, was mainly to make heavy tools for splitting wood, or very small adze blades, which rarely circulated further than the distance covered in a two to three days' march. The fact that these brown and black schists and relatively weak metamorphic rocks were taken from torrent beds, minimally flaked and mainly shaped through grinding (Fig. 5) makes it easy for us to understand that they were accorded a low social value, and that they scarcely featured in collective ceremonial exchanges.

Here, then, rapidly sketched above, is the essence of the stone axehead in New Guinea: it is a tool for men's use, indispensable to the physical reproduction of agricultural communities, but also much more than that: a piece of sacred material, surrounded by myths, rituals and stories that accompany it over long distances in its various exchanges and transfers.

Direct access and specialisation

So far as the production of stone axeheads in New Guinea is concerned, to attempt to rationalise this phenomenon in terms of a sequence of technical acts (i.e. by employing the concept of a *chaîne opératoire*, as used by those who specialise in prehistoric technology and whose perspective excludes consideration of social aspects) may be indispensable, and yet it is insufficient. What is indispensable is the use of

the general concept of a '*chaîne opératoire*' – as conceived by ethnologists who focus on techniques of manufacture and use (Lemonnier 1970; Pétrequin & Monnier 1995) – examined within the context of the social controls and prescriptions which necessarily accompany it. To answer the question 'how does one produce a polished stone axehead?' it is necessary to ask the associated question: 'who does what, how, when and why?' In effect, the most elementary technical acts form part of the functioning of society and risk becoming incomprehensible if they are divorced from their context. This is why western, 'common sense' approaches that seek to apply the law of least effort and the law of maximum return to the understanding of stone axehead production in New Guinea, or indeed in prehistory, cannot constitute valid scientific explanations.

To begin our more detailed investigation into the circulation of stone blades in New Guinea, we need to remember how, and at what rhythm, the exchange networks are supplied from the source areas, from the extraction expeditions. Two contrasting case studies suggest themselves – leaving aside (as being of negligible significance) those acts of episodic, individual production of axeheads of mediocre mechanical quality, using cobbles gathered from torrent beds. The question of the level of technological know-how (and its consequence, the question of whether production is done by the many or by the few) is essential in distinguishing between the two case studies.

In the first example, illustrated by the extraction of stone in the Yeleme massif, the level of *savoir-faire* is rather low and all men can acquire it, because the apprenticeship period is short. As a result, the commonest mode of exploitation is by expeditions of men from virtually all the communities lying within a three- to five-day journey from the massif. How these expeditions are carried out is regulated by various rituals at the quarries – as mentioned above – but above all, by the relationships that have been established around the quarries between the communities who speak Wano, Moni and Dani. Without these relationships (which are essentially achieved through marriage, and established by the Proprietors of the Land), these direct-access expeditions would be dangerous or impossible. Despite this, the desire to brave the political and ritual interdictions and to go to the Yeleme quarries (or, elsewhere, to the salt sources in Moni country, another source of wealth) has been demonstrated by the Dani of North Baliem who, throughout the twentieth century, preferentially exploited the best



sources of axehead rock and the richest brine springs (Larson 1987; Pétrequin *et al.* 2000). In each valley, the cycle of wars, occurring every six to nine years, is another powerful factor regulating direct-access expeditions: any such expedition can only take place during periods when peace has been re-established and funerary compensation has been paid with pigs, axeheads and salt (Larson 1987). Under these social conditions and at the scale of the exploited area in the massif, production from the quarries has ended up being massive, with communities over a large area enjoying direct access, even if the individual expeditions are episodic and take place at irregular intervals.

We must however remember that not every man in the region in question participates in such expeditions, which are undertaken in a mountainous area that can be difficult and sometimes dangerous to traverse. Exploiting the Yeleme rock is a task for warriors who rapidly accumulate temporary wealth and acquire an incontestable social aura; other men prefer the simpler life of staying in the village and concentrating on cultivating their garden plots and raising pigs, to produce resources that, like axeheads, can be used in compensatory payments. The most recent exploitation of the Yeleme quarries has been undertaken by a particular kind of warrior, the 'entrepreneur' (Pospisil 1963), who seeks to make a rapid material and social profit and is willing to take risks to achieve this.

The second case study concerns those exploitations which require a high level of technical skill (duly regulated by ritual, of course). These are undertaken by part-time specialists, who are the only people capable of producing top quality stone blades; their technical knowledge is complex and is shared only among certain lineages. The exploitations at Langda, Sela and Suntamon offer good examples of this sophisticated process of flaking; similarly, those at Ormu and various villages around the Cyclops Mountains exemplify excellence in the creation of long axeheads formed entirely by pecking (Wichmann 1917; Wirz 1928). In theory, direct access to the stone sources would be possible for other groups (on condition of their maintaining alliance relations with the Proprietors of the Land), but these strangers would only be permitted to take away rough, unshaped blocks of low value and they would not have the appropriate *savoir-faire* to create high-quality axeheads. Thus, production of the latter rests entirely in the hands of the technicians (and the ritual specialists) who live at least one day's march away from the outcrops.

Production, always on a large scale, is governed by the rhythm of ritual exchanges between villages: on the one side of these exchanges are the specialist axehead producers, and on the other are communities that exploit different ecological niches, either at higher altitude (whose exchange goods are birds of paradise, decorated woven bags, pigs, tobacco and garden produce) or in the Lowlands (who offer bows made from laurel wood, marine shells, sago palm flour, pottery and dogs' teeth). All these products regularly change hands during festivals linking partner villages (festivals which are called *mote* in the Eastern Highlands).

In actual fact, a prehistorian would have difficulty in distinguishing between these two modes of production unless s/he was able to evaluate the levels of expertise and technical specialisation involved on the basis of the working debris left at the quarries and in the villages. As regards the geographical distribution of axe- and adzeheads from the source areas, in spite of the fundamental differences in the social contexts of production between the system of expeditions run by 'entrepreneurs' and that which operates on the principle of ritualised exchanges between partner villages, the end result is the same: large numbers of roughouts move outwards according to a cyclical rhythm. The distribution patterns relating to each of these cyclical episodes of production rapidly blur into each other within the overall context of the mountainous massifs where exploitation takes place, because of the sheer number of different exploitations carried out by different communities, each one regulated by specific social rhythms. The discovery of unpolished roughouts far away from the quarries could be a good indicator that such large scale episodes of production have taken place.

In each of the two case studies discussed above, the process of large-scale production – whether it be undertaken by non-specialist 'entrepreneurs' or by specialist 'traditional partners' – produces masses of roughouts and of blades ground or polished to varying degrees, which enter in large numbers into the inter-community or inter-individual transfers. This centrifugal movement does not seem to diminish in its force the further that the products travel away from the quarry: this runs contrary to the classic model of 'down the line' exchange (Hodder 1976; Renfrew 1975, 1977). The reason for this is that the principle underlying the exchanges is to have an ever-replenished supply of items to give to one's partners.

Naturally, the notion of making a profit –



attaining material wealth, winning social prestige – is far from absent in these transfers of axeheads, pigs, marine shells, salt and products of the forest and of the garden. However, globally, every man can procure his own axeheads, feathers, shells and bows which are necessary to the signalling of his social status and cultural identity. The idea of solely making a material profit – that is, hoarding material for one's own benefit, keeping it in a treasure store and passing it on to one's descendants – is not absent, but usually it is secondary to the concept of social and political profit (in the form of parading this wealth in public, making a reputation, establishing a clientele and a network of partners and allies, and momentarily achieving a position of dominance). The same is true of those villages on the coast or the islands which specialise in ceramic production (Irwin 1984). In spite of the famous counter-examples among the Big Men in central Papua New Guinea (Burton 1987) or on the north coast of West Papua, this system in which wealth is in constant circulation conforms well with the image of relatively egalitarian societies, in which hereditary transmission of social status occurs only exceptionally (Lemonnier 1986). We shall return later to the exceptions in question.

Finally, the limits of these long-distance exchange systems cannot simply be thought of in terms of kilometres' distance as the crow flies, or of days of marching, especially since the diffusion of axeheads, of salt, of shells and of feathers is not identical in each direction emanating from the centres of production. Instead, we have to learn to conceptualise in terms of the social distance between the different communities involved in the transactions (Pétrequin & Pétrequin 1993). In fact, an exchange system can 'run out of steam' or become interrupted if the right social conditions for the circulation of polished stone blades are not in place. These limits often coincide with the temporary fronts created by wars; by contact with traditional enemies; by the passage of other linguistic groups through the area, with whom contact has not yet been made. In contrast, what helps to make a system run smoothly is relative sedentism and intermarriage, long-held contacts, acculturation, traditional partnerships, colonising movements and the competition between men that is offered by feasts and by masses of socially-valourised objects. These provide an effective medium by which a man can gain renown and, sometimes, power.

Tools whose use is socially prescribed

So, here we have men who are equipped with an adze or an axe, slung over their shoulder, which they want to polish and re-use for a long time. But these tools of forest clearing, sometimes used as weapons in combat, are not simply technical tools, as Axel Steensberg had thought (1980). Rather, they are already social signs which – just like bows and arrows – signal that their owners have gained membership to adult male society. Moreover, the ways of hafting the stone blades and of lashing them to the haft vary from one region to another (Sillitoe 1988), thereby enabling the viewer to assess the cultural proximity of different groups just by looking at an axe or adze. From these different ways of hafting one can also trace the long history of innovations which had arrived in New Guinea on the north coast and which were progressively transmitted inland towards the interior (Pétrequin & Pétrequin 2006). Thus, in common with other tools, axes and adzes would appear to be socially prescribed artefacts (Lemonnier 1986).

In some cases, the extent and intensity of surface polish on stone axeheads tends to increase with increasing distance from the parent quarry. This relates to the desire to show off with a particularly fine-looking social symbol, and it involves a considerable investment of time over and above that spent by the original makers. These axeheads demand an even more sophisticated social interpretation (Højlund 1981). Among the Wano and Dani, young warriors, at the age when they are competing to affirm their authority in society, tend to carry around in public axes with long, heavy blades, hafted in a single-piece haft. They try to fell trees using these very heavy tools, despite the fact that older men work quickly using axeheads that scarcely exceed one to two kilograms and which permit them to fell trees collectively, in a group effort to open new garden areas in the forest.

This process of social differentiation is even more obvious on the northern coast of West Papua, in the Sentani culture around the Cyclops Mountains. During public ceremonies, certain hereditary chiefs (the *ondoafi*) of dominant lineages, who are considered to be direct descendants of the Proprietors of the Land, use axes with blades of rare rocks, which are very regular in shape and have been polished for a long time by rubbing against the leaves of the Nibong palm (Figs. 6 and 7); sometimes the axeheads are also enveloped in latex, to make them



shine 'like water', as they say (Pétrequin & Pétrequin 1993; 2006). These axeheads with their mirror-like polish, presented in the hand, unhafed, are symbols of social status and power. They are carefully curated, kept within organic cases and rarely touched with fingers, so as not to dull their brilliance. As for ordinary men, who belong to lineages deemed to have arrived recently in the region, not one of these is allowed access to these axeheads that are treasured by the elite. These axeheads are extraordinary in their raw material, the quality of their finish, and also in their history, their biography. It can also be the case that small but very ancient axeheads are also prized more highly than the longest examples, by reason of their biography: owners can cite from memory a long litany of the successive previous owners. By virtue of his power, an *ondoafi* can thus accumulate a score or so of very highly polished axeheads which he has acquired through inheritance or by receiving marriage compensation payments, or blood money (Fig. 8). In some cases, such axeheads may be acquired through hostilities. However, in general, many of these special axeheads are destined to be given away in public ceremonies to establish exchange partnerships, to re-establish peace, or to seal exceptional marriage alliances with other elite families.

Sometimes a set of axeheads may not be the property of a high-ranking individual, but rather of a dominant lineage. In these cases the axeheads reside in the sacred house in the village, a large polygonal structure as seen in the Humboldt Bay area, close to the city now called Jayapura (Galis 1955). Such axeheads were considered as sacred objects, given by a Primordial Creature; they were inalienable, and enabled a lineage to substantiate its claims over land and over people (Godelier 1996; Pétrequin & Pétrequin 2006).

The concept of such sacred objects is found throughout the Sentani culture, where in addition to axeheads the category encompasses glass beads, believed to have been gathered from beneath the Bead Tree in the Land of the Sko people, and glass bangles which, as everyone knows, are the vertebrae of the Great Python. These sacred objects are given to a partner in exchange for other socially-prized objects, or are given in payment for a serious loss. The value of each axehead, bead and bangle (Fig. 9) is discussed on a case by case basis and according to its colour, its transparency, its lustre and according to the respective social standing of the donor and the recipient. The practice of giving axeheads as funerary com-

pensation or marriage payment would seem to suggest that these ancient 'tools' in fact represent the equivalence of human lives, as is the case with pigs in the Highlands (Lemonnier 1990) and with pearl rings, loaves of salt, imported fabrics and Chinese porcelain in the north-west of West Papua and the islands in the Bay of Cenderawasih (Pétrequin & Pétrequin 2006).

The same phenomenon is known among the people of the Dani linguistic group, in the Highlands of West Papua. Here, the social interpretation of stone axeheads in terms of their equivalence with human lives is even more obviously expressed. In these communities where the population is very dense, people hoard, exchange, give and receive *ye-yao* (Fig. 10). A *ye-yao* is a long blade in greenschist or amphibolitic schist, from the secret quarries at Awigobi, in the heart of the aforementioned Yeleme massif (Pétrequin & Pétrequin 1993; 2006). Awigobi signifies the 'River of the Night', the flow of water along which the ancestors proceed at night with their torches, in their search for these long schist plaques that emit a luminous greenish glow in the dark. In other regions, such as southern Baliem Valley, it is said that these long slabs had been the splinters of Yeli, the Sacred Tree dating from the beginning

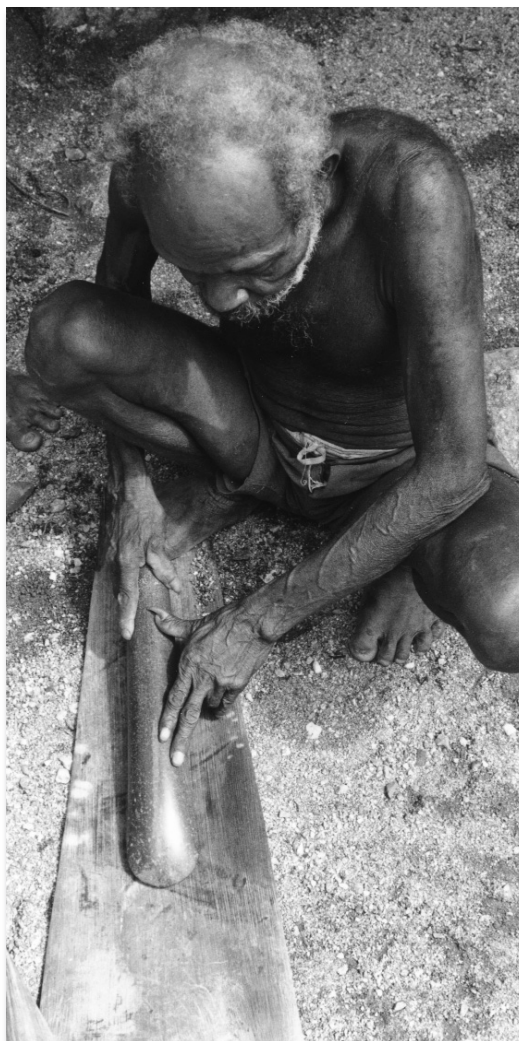


Fig. 6.
Polishing to a high
sheen of a long axehead
by rubbing against
a bed of leaves of the
Nibong-palm, very rich
in phytoliths.
Ormu Wari
(West Papua, Indonesia),
Ormu group, 1984.

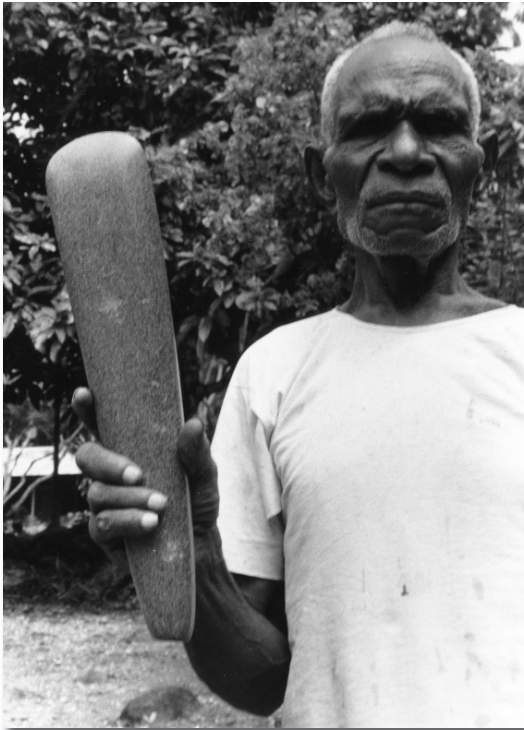


Fig. 7.
Presentation of a long
serpentinite axehead
by one of the two
traditional chiefs of
the village of Ormu.
Ormu Wari
(West Papua, Indonesia),
Ormu group, 1984.

of the world (Zöllner 1988). In reality, the stone at Awigobi was worked by fire-setting, flaking with a hammer and then longitudinal sawing. This process produced not only the most highly-prized objects (the *ye-yao*), but also knives for peeling taro tubers, and adzeheads, much used by the Moni and the N'duga. Thus, one part of the production at Awigobi had been selected and diverted from its primary technical function (i.e. the manufacture of axeheads and adzeheads). These *ye-yao*, after being sawn and carefully polished, were dressed in a miniature skirt and in pendants made from the fur of the tree kangaroo (Fig. 10), in order to transform them into women of stone. Here, therefore, we are dealing with veritable anthropomorphic representations, of symbols equivalent to human lives, known and accepted by all as such. Among the Dani, the *ye-yao* (or exchange-axeheads) were given as marriage payments, as funerary compensation and for the payment of blood money (O'Brien 1969). Thousands of these axeheads circulated around



Fig. 8.
Axeheads and roughouts
belonging to one of the
two traditional chiefs
of the village of Ormu.
(West Papua, Indonesia),
Ormu group, 1984.

the Dani of West Papua and in the Baliem Valley, never to be seen publicly except during payment rituals.

Among the long axeheads, of varying length – the largest one that we have observed being 90 cm long – certain examples had an altogether different value. Lacking clothing, but smeared with pig fat over a long period, the *ye-pibit* were sacred objects kept exclusively in mens' houses among the Dani and in sacred houses among the Yali. They were priceless to their owner or to a lineage: these were sacred items that were kept secret, because they held within them the power of a Great Warrior who had been killed in combat, or had been the gift of a powerful Spirit. The *ye-pibit* only exceptionally saw the light of day, after a pig had been killed in order to nourish the axehead (thereby renewing the coating of pig fat), on the occasion of a ritual of collective healing, for a magic ceremony to ensure the fertility of the gardens, or to celebrate victory in combat. Others were never seen in public, because in them resided the power of a lineage or the salt content of a well-known brine spring. Here once more we find the idea of sacred objects, which are living pieces of the Primordial Beings: this is what accords them their value as items to be given or exchanged (Godelier 1996; Pétrequin & Pétrequin 2006).

We should therefore not be surprised to observe that in New Guinea and its neighbouring islands, certain axeheads are still presented in public, even though workaday stone axeheads had long ago been replaced by their counterparts in steel. The example of the Trobriand Islands cited by Bronisław Malinowski (1935) describes a garden magic ritual where a colossal axe, with a polished stone axehead from the distant island of Woodlark, was carried with great ceremony around the gardens to restore their fertility. One could also mention the highly polished axehead that found its way from the north coast of New Guinea, to the treasury of the Sultanate of Tidore in the North Moluccas, around 1500 kilometres as the crow flies to the west. This axehead from the Cyclops Mountains takes its place there among objects of gold and silver (Pétrequin & Pétrequin 2006).

Conclusion

All these examples are far from being exceptional (Weiner 1992). One finds similar phenomena in Polynesia and in New Guinea, where a nephrite axehead was considered to be



Fig. 9.

Serpentinite axeheads polished to a high sheen, and rings and beads of coloured glass, from the treasury of one of the two traditional chiefs of Abar. Abar (West Papua, Indonesia), central Sentani group, 2008.

so valuable that a war could break out over its appropriation (Best 1912). These recent ethnographic situations give us a very good idea of the continuum of social interpretations which can make a stone tool, extracted from the living rock that belongs to the Dream Time, into a sacred object – a gift from the Primordial Beings. What we see, then, in these stone symbols that form the basis of exchanges and gifts, circulating over long distances and being manipulated by men for their profit, is the investment into them of an ideal value that is accepted by everybody, since it arises from profound religious convictions.

These ethnographic examples, featuring contemporary New Guinea societies that are only weakly stratified, have taken us a long way from Neolithic Europe, but have guided us along paths that are much more complicated than a simple binary opposition between 'workaday' tools and 'prestige items', to use the well-worn phrases. Further examples could easily be found in less egalitarian societies, where power rests with divine rulers. For example, in Mesoamerica, Guatemalan jade objects were reserved for use by the elite and by the gods: these were funerary masks, beads and

Fig. 10.
Exchange axehead of
amphibolite schist,
dressed in a married
woman's skirt and
adorned with fur
pendants.
Pyramid (West Papua,
Indonesia), Dani group
of North Baliem, 1984.



pendants, and also consecrated polished axe-heads, bearing engraved inscriptions and anthropomorphic representations. Finally, one could consider the character 'yü' which signifies jade in China: at the bottom and at the top are two horizontal lines, representing the Earth and the Sky/Heaven, and linking them is a vertical line that signifies communication between the two worlds. This communication is undertaken by the Emperor himself, the divine ruler (represented as a short horizontal line midway between Heaven and Earth), by means of a polished axehead of jade (shown as a little oblique stroke beside the Emperor's short line). It is clear that what this character signifies is the mediatory power of the Emperor and of the jade axehead, in a society where absolute power was also founded on religious beliefs.

At different scales, one can see that it is the same basic idea that is being expressed in these ethnographic and historical instances: the axe-head, having become a sacred object, participates (along with other symbols such as the ring, the cross, *et cetera*) in communication between the different worlds and in religious power. Perhaps, then, in this we may have found various new keys with which to approach the functions of polished stone axeheads in Neolithic Europe. We need to take into account, of course, the contexts in which the axeheads have been discovered: this aspect is essential to

our understanding, and yet is all too often ignored by specialist studies, which focus as they do on petrography, on technology or on typology. At stake is a truly complex situation. In order to address this, we need not only meticulous analysis, carried out according to the criteria of hard science, but we also have to apply, in an integrated manner, the entire methodological armoury of archaeology, of history and of ethnology. We now need to start afresh with the archaeological material, to create theoretical reconstructions of the past which incorporate religious and ritual dimensions, and to construct narratives of Neolithic societies that are a lot more complex than those that have been, and are currently, offered by the various partners in archaeological research.



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Films

- Langda. L'herminette de pierre polie en Nouvelle-Guinée*
1990 film 25 min, producer B. Théry, directors B. Théry, P. Pétrequin and A.M. Pétrequin, production J.V.P. Films, CNRS Audiovisuel et CRAVA, distribution CERIMES, Paris.
- Yelemé. La hache de pierre polie en Nouvelle Guinée*
1991 film 25 min, producer B. Théry, directors B. Théry, P. Pétrequin and A.M. Pétrequin, production J.V.P. Films, CNRS Audiovisuel et CRAVA, 1991, distribution CERIMES, Paris.
- Ormu. La hache d'échange en Nouvelle Guinée*
1994 film 20 min, producer B. Théry, directors B. Théry, P. Pétrequin and A.M. Pétrequin, production J.V.P. Films, CNRS Audiovisuel et CRAVA, distribution CERIMES, Paris.





■■■ A ground stone blade in private hands. A marked asymmetry in the profile of the cutting edge suggests hafting and use as an adze. A deep and invasive flake scar emanates from the cutting edge and the even nature of weathering suggests that this is probably a break of some antiquity. The nature and source of the stone is difficult to determine. The dark and mottled colour suggests Porcellanite or something similar, but without analysis it is impossible to be sure.

Right now, however, that's not very likely. For Jill C, what matters is that the blade belonged to her grandfather, who died back in 2001. When she was a child, he'd often show her things he'd found while out in the field, and always encouraged her to keep an eye out when they went walking together. Of course, he'd had to give up his tenancy on the farm long before she was born, but he'd kept the blade, along with a few other bits and pieces. Most were *'in the drawer somewhere'*, but the blade was different. A permanent fixture on his mantelpiece, it was something to be handled and handy when unpaid bills or other papers needed holding in place (Jill remembers; *'the house was full of draughts'*). Now it rests on hers. So *'no thanks'*. It would be nice to know where the stone was from, but not if it meant cutting a slice or drilling a hole. Her grandfather would spin in his grave. ■

●●● *It was just a passing comment. Someone said a friend had an old axe that a relative had found while ploughing. Could I have a look? A month later, an envelope arrived. I'd forgotten all about it, but my heart kind of juddered when a complete jadeitite axe slid out from the thin and insufficient packing. I don't know how it made it through the post, or how it stayed intact. But it didn't go home the same way. ●*

Neolithic near-identical twins:

The ambivalent relationship between 'factory' rock and polished stone implements

Abstract

An important principle of British-Irish implement provenancing schemes is that 'grouped' implements (those given locations of origin to primary outcrop) should share precisely identical lithologies. A brief review of groups I–V, VI, VII and XVIII, however, shows that there may be wide variation in the mineral composition of some groups. It is suggested that this differential composition enables working qualities in the stone: to allow flaking or pecking, and polishing. Flaking is enabled by minerals that determine fissility and perhaps even fragility. Greater durability results from compositions favouring homogeneity within lithic mass that protect against regular cleavage or fracture. This disables flaking potential, making it possible only to peck or polish the stone.

This differential composition may explain distributional coincidences between some glacially re-cycled erratics and polished stone axes deriving from the same country rock. Since flakable stone survives only limited distances from source in ice carriage, the polishing of stone axes of Lake District origin in E and NE England (and probably elsewhere) may be attributable to natural deterministic causes, rather than to human carriage.

This hypothesis should be tested by the detailed re-examination and publication of all the petrographic sections from British-Irish grouped axes.

Introduction

Belief in long distance trade or the exchange of Neolithic stone axes in Britain and Ireland remains strong (Bradley & Edmonds 1993, 2005; Cooney & Mandal 1998), despite caveats that have yet to be addressed before the case can be fully justified. Serious questions raised about the integrity of the evidence over the last forty years, include the following:

- * First, high percentages of the (mainly polished) stone implements sectioned are of materials that cannot be easily 'grouped' petrographically, so they are without provenance. There is general agreement that this component was probably produced locally from re-cycled materials (Clough & Cummins, (eds), 1979 and 1988 *passim*), though full publication of their detailed petro-graphies would very much assist the progress of the study;
- * secondly, the evaluation of implement petrographic thin-sections remains hampered by the relative absence of provenancing studies for re-cycled rock (Briggs 1976–2009). The challenge to rectify this situation has been taken up only in the last decade (Jones & Williams-Thorpe 2001; Williams-Thorpe, Aldiss *et al.* 1999; Williams-Thorpe, Potts *et al.*; Williams-Thorpe, Webb *et al.* 2003);
- * thirdly, it has been proposed that working quality and tool form by flaking or polishing are likely to have been determined by slight, though significant mineral differentiation within some implement 'groupings' (Briggs 1982–2009);
- * and finally, although practical efforts are being made to bring together all implement petrographic thin sections, it is clear that the available written descriptions on the implements ascribed to the groupings so far defined are insufficiently detailed adequately to provide lasting answers to the preceding questions.

Although the object of the present paper is mainly to expand upon the third point, it will be necessary to explain some of the problems that arise from the others, as all are interrelated as regards finding solutions to explain, qualitatively and quantitatively, lithic procurement patterns.

Background: The objects of CBA implement petrology scheme

During the 1930s a scheme of petrographic thin-sectioning was initiated in the British Isles intended to provenance stone axes of more exotic stone (mainly non-flint material). Specific stone types were eventually given the Roman numerals I–XXXII. Polished stone axes that could be matched to stone from the same exposures apparently proved connections with distant workshop sources, thereby demonstrating a manufacturing process in which flaking was followed by polishing. This seemed to be an ideal demonstration of prehistoric industry and trade, with few interpretational caveats (Clough & Cummins 1979 and 1988, *passim*).

A point of important retrospection was reached during the early 1970s, when W.A. Cummins, then the chairman of the CBA Implement Petrology Committee, produced isoplethic maps of (mainly) polished stone axe distributions (Cummins 1974, 1979, 1980a) offering graphic evidence for apparent trade in the implements. Efforts were made at that time to relate these maps to patterns of glacial dispersal and to the Cornubian origins of the Triassic Bunter Pebble Beds of the Midlands (Briggs 1976–89: *see* Briggs 2009) which would suggest a dependence on local materials. In the main, however, the inclination is still to accept the petrographic ascriptions as indisputable evidence of a prehistoric trade. Any evidence contrary to the belief in trade can on occasion be overlooked or obfuscated by not citing investigations obviously relevant to the problem (e.g. Cummins & Harding 1988:80–81).

A narrative of the problems beset when Neolithic trade theory was confronted by the relatively new dimension of erratics and recycling in the 1970s and '80s has been presented elsewhere (Briggs 2009).

The coexistence of implement flaking and polishing.

The coexistence of flaked and polished implements was first explained by Sir John Evans in his magisterial *Ancient Stone Implements* (1897: 67) almost a century before Coope re-iterated the observation (1979:98–101). Coope saw the origins of the two techniques in terms of both social competition and economy, on the one hand, and in relation to the availability of the raw material on the other. He did not appear to see any obvious relationship or determining factor between function and lithic composition.

Not long before Coope wrote, Helen Mayoh, a Birmingham student who had studied the petrography of the Langdale factory sites, pro-

posed that 'exported' polished axes of Group VI material may have been fashioned from any one of several rock-types occurring throughout the whole Borrowdale massif (1976a, 1976b and 1978) – an area covering many hectares. At a lecture given to the Edinburgh University Archaeology Department in 1980, Cummins subsequently pointed out that in his experience of examining axe thin-sections there was apparently a great variation in the range of minerals acceptable to petrologists within the definition of Group VI. In particular, he felt that the inclusion of epidote, though common in the factory areas, was relatively rare in the polished axes believed to derive from them. On the other hand, leucoxene was mentioned as having a stronger presence in some axes than in flaked ones (Cummins 1980b). This observation prompted the writer to suggest that specific minerals may have been responsible for the fissility which made some quarried or relatively unsorted stone attractive, because it made the stone easier to work (Briggs 1982:152).

The discovery of a Palaeolithic hand axe from Brandon, Warwickshire, fashioned from a piece of glacially-carried epidotised tuff (Fennell & Shotton 1977) illustrates the principle under discussion. Ice-borne epidotised tuff pebbles that had travelled so far are anyway quite unusual, as their mineral composition would likely cause them to be lost to thermal or percussion fracture. At least two broadly similar examples are known, one of epidotised porphyritic andesitic from Hilton in Derbyshire (Posnansky 1963:376, fig 8.5, 391), the other from Beckford, Worcestershire (Fennell & Shotton *loc.cit.*:13).

It is also felt that differences between the mineral constituents of 'traded' axes and their 'factory' counterparts for both Groups VI and XXI might be explained by reference to the glaciations of Langdale and of Lley. During Pleistocene ice movements, the most fissile rocks would have disintegrated through thermal or percussion fracture (in the same way as does poor quality flint); only the harder, amorphous, less fissile rocks from near the 'factory' areas would be likely to have survived. Some pecking into shape prior to polishing is probably the most the dynamic of non-fissile pebbles could withstand and attempts to flake unsuitable pebbles would probably result in percussive shatter (Briggs 1989:17–19). The limited evidence suggests that suitable material would be more difficult to flake and progressively more difficult to find, with increasing distance travelled from source (Briggs 2009).

Groups 1–V

Non-flint flaked tools are common components of the Palaeolithic repertory of the English Midlands (Posnansky 1963). There the most common implement-making material is quartzite (an 'ungrouped rock') derived from the Bunter Pebble beds, the ultimate origin of which may well lie beyond the Cornubian peninsula. Other inclusions in the Bunter are less well known, but its greenstone component is probably coincident with stone types used for making polished axes, which also derive inferentially from the southwest (unpublished research on IGS petrographic registers). The southwestern Neolithic artefacts were originally grouped I–V. These are mainly uralitised gabbros, epidiorite or greenstones in which the main accessory mineral is ilmenite, often altered to leucoxene (Keiller *et al.* 1941).

In 1994, in an exceptional statement chronicling and summarising implement petrographic problems from a southwestern viewpoint, Peter Berridge demonstrated how Cummins's 'relative distribution maps' of 'Cornish' axes were misleading and showed that they gave disproportionate visual weight to stone over flint axes in their occurrence eastwards from Cornwall (Berridge 1994). Concern for the continuing absence of any southwestern 'factory sites' was also expressed after many years' fruitless searching (Berridge *idem*:47–8); furthermore the mineralogy defining petrographic groupings 1–V was shown to have little value in distinguishing one defined 'group' from another (*idem*:46, 48–51).

Questioning the accepted chronology of lithic resource exploitation (p.48), and aware that pebble and gravel components of the Southwest and South of England remained inadequately studied, Berridge concluded that far more lithic implement dispersals than hitherto imagined may prove to be reflections of natural processes. One of the main deductions to be reasonably drawn from these observations, is that the flaking technique seldom appears to have been employed in fashioning Cornish axes probably because presumably the mineral suite that dominates their composition disables any quality of fissility.

Group VI

Axes of Borrowdale Volcanic material originating in the English Lake district have long dominated the whole concept of Neolithic implement trading in Britain and Ireland. Group VI stone currently defines the most prolific axe population identified and provenanced from hundreds of stray finds and taken from a

variety of excavated sites across Britain. Among the Langdale Pikes there are working floors and even an extraction adit that exploited a band of epidote-rich stone among the Langdale Pikes. As already noted, the area had become Britain's prime exemplar in the Neolithic stone axe manufacturing and trading industry by the 1970s.

The unsatisfactory nature of the evidence underpinning the implement trading theory led the present writer to examine them closely in a review of Group VI Cumbrian stone published in 1991 (Briggs 1989). This review considered the form, wear and natural attrition of 'rough-out' implements, discussing the environmental, cultural and antiquarian aspects of their find-spots, and concluding that they were flaked for local use in tree-felling or agriculture. The character of the axe 'factories' and their products were also described and discussed. Detailed lists of re-cycled stone found within and outside the Lake District were presented and their distributions compared and contrasted with those of the artefacts. The widespread occurrence of glacial erratics across much of southern Britain petrographically similar to Group VI was demonstrated and these were considered to have been the most likely sources for procuring the polished implements. It was deduced that the implement 'factories' had been mainly of local significance. Programmes of collecting and petrographically examining erratics were advocated in order either to uphold the integrity of long-distance 'trade' and 'exchange' or alternatively to more clearly illuminate patterns of random collection and scavenging from recycled pebble resources.

That study was prepared and submitted for publication just as fresh investigations and research were being undertaken around the factory sites in Langdale. This fresh research was not published until 1993, so its conclusions could have taken aboard all the serious points already raised (Bradley & Edmonds 1993, 2005 *passim*). But the book's title betrays its foregone conclusions: *Re-thinking the Axe Trade*. So titled, it might appear that from the outset there was no serious intention of thorough exploration to scrutinise the processes whereby raw materials were acquired.

Consequently the text only acknowledges that 'whilst most of the raw materials were obtained from their natural sources, an unknown proportion of the axes were made from glacial erratics of the same composition, and these can be found in different parts of the country (Briggs 1976, 1989)' (see Bradley & Edmonds 1993:38). Later in the book, the emphasis shifts to assert how 'nearly all the

axes of Group VI did originate in Cumbria, the exception being those artefacts made from glacial erratics' (71–72). Later still, it is accepted that 'a few stone maceheads [were] made of erratics' (*idem* 189).

The authors nevertheless then go on to concur that

in some ways glacial erratics pose serious problems. Indeed, the fact that the full extent remains unmapped has been thought to discredit the whole idea of an 'axe trade' (Briggs 1976 and 1989) – a rather eccentric argument which could only be sustained in the absence of large production sites. In fact the existence of such erratics helps to define the characteristic features of this system, for here was a source of stone with similar properties to those imported from distant areas. The significant difference lies in the nature and extent of polishing. Axes made from local erratics were seldom polished completely. This has two implications. First it was considered that the origin of the material was more important than its physical characteristics. This may be because exchanged items carried with them a history of relations between people. Secondly, the fact that axes made from materials with similar properties received different treatment according to their area of origin shows the extent to which such judgments were socially determined. They were not a response to practical problems encountered during use. The significance accorded to particular artefacts, as manifested in their treatment, depended more on their cultural biographies (Bradley & Edmonds 1993:50).

What has to be deduced from this statement is that Bradley and Edmonds make these value judgements about the quality and quantity of availability lithic resources without presenting any serious assessment of glacial dispersal from Borrowdale, either at first hand, or from the literature, as well as in the near-total absence of any petrographic or geochemical programme provenancing the erratics dispersed from the area over much of Southern Britain. Indeed, by introducing the potentials of social and economic behaviour to the argument before even reaching an understanding of the printed literature on the subject seems to put the cart before the horse. And here the authors have introduced more unknowns through a statement in which unsupported assumption becomes asserted fact without clear explanation of its evidential base. A categorical pronouncement without any degree of misgiving, it also fails to

appreciate any other potential interpretations that could be deduced or traduced from data observed around the 'factory sites'. It might reasonably be asked how it is possible to distinguish between the stone that was humanly imported and that which was naturally carried if local erratic populations have never been examined to the same degree as the axes? And without further understanding of the variable composition within Group VI, how can it be known why some implements were only part-polished? It must be clear that the serious questions posed about glacial erratics in Briggs 1989 (18–28) have not been properly understood, or they would surely have been acknowledged, if not, addressed.

Neither is there any mention of how variable petrography within Group VI may have related to finished implement form (Briggs 1982, 1989), so claims for long-distance trade and contact are based upon uncritical use of the implement 'grouping' system (though some examples of re-assignments from one group to another are mentioned, the text fails to explore how variable petrography and the inclusion of the mineral epidote within Group VI (or mineral variables in other grouped implements) were likely to have affected the working qualities of the stone. Yet seen in relation to the widespread availability of Cumbrian greenstone erratics, it makes good sense to equate the difficulty of flaking epidote-free erratics with the presence of so many far-travelled Group VI tools that were actually polished.

Unfortunately, the theoretical side of the book is so structured as to set little value in discussing erratics and re-cycled stone, or in re-examining the potential functions of the worn flaked axes. These continue to be called 'rough-outs', a term for long connoting that all had been production line components in the assumed 'trade', when in fact no new evidence has so far been presented to clarify or revise the conclusion that after detailed macroscopic examination of eight such artefacts, rather than implements in transit, these were more likely intended for local use in the flaked form and may have been deliberately sharpened to be used for felling local softwood forest (Briggs 1989:3–9, 35–6 and pls I–V).

Bradley continued to downplay the part played by re-cycled stone as potentially the main resource for Neolithic stone axe supply in a later study, though again without reference either to studies of re-cycled stone or to any of the other serious investigational unknowns of lithic implement study (Bradley 2000:86–7).

In 1989 an explanation of the relationship between scree exploitation and environmental change was proffered (Briggs 1989:15–16). It suggested that initially extraction pits had been dug into the steep, vegetation-covered screes which at an unknown point began to degrade and slide after livestock had grazed away the binding ground cover. Given that so much of the book's interpretation depends upon work undertaken on those very screes, it seems odd that this proposal should not even have been mentioned.

Interpreting the Axe Trade is a fascinating narrative explanation about the presumed lives and works of later prehistoric craftsmen, traders and even of mountaineers, all cast in a mould attractive to the present-day imagination. But this is narrative based upon hypothesis at present still unsupported by investigations into the natural, geological environment and into the petrography of lithic resources to demonstrate the adequacy of the implied evidence and integrity of its conclusions.

Group VII

Like the Lake District, North Wales was heavily glaciated, and erratics from the area were scattered multidirectionally. Also in parallel with the Cumbria, the discovery of a Neolithic stone axe 'factory' at Graig Lwyd, Penmaenmawr around 1920 (Warren 1921; RCAM 1956; [much of the site has been subsumed into modern-quarry workings]) has strongly coloured interpretations of how Neolithic implements were made and dispersed. An examination of some 'products' believed to have originated at Graig Lwyd is illuminating.

At Bryn yr Hen Bobl megalithic tomb on Anglesey, for example, large convex scrapers (Clark 1936:289–290, Fig.7, nos 9, 10), a chisel (Fig.7, no.12) and secondary edge-trimmed flakes (p.290, Fig.7, nos 7–9), were of Graig Lwyd stone which Clark believed had been struck from axes imported onto the site. Complete axes certainly of Graig Lwyd rock were absent from the assemblage, and Hemp, the site's excavator, observed 'that while the complete axes [were] all of local material, the many flakes [were] of imported Graig Lwyd stone, some struck from polished axes, the bulk from blocks of raw material' (Hemp 1936). However, given the known glacial dispersal of North Wales rock there is every reason to believe that the flakes could or would have been just as easily struck from locally-procured erratics, rather than invoke the human transport of either artefacts or these particular raw materials.

More recently, the idea that techniques for working group VII flaked and polished axes may have been determined by variable petrology within the grouping was suggested for implements of Penmaenmawr 'factory' and Group VII rock (Williams 2000). Williams noted finds of a handful of flaked implements (using the term 'roughout') relatively close (within c 20km) to the original 'factory' location. He discussed their form and occurrence in relation to polished implements and suggested that the difference was probably due to variations in the lithology of the country rock (Williams *idem*). Clearly the mineral composition of this Group merits re-evaluation. It is also noteworthy that when C.H. Houlder drafted the RCAM's account of the Penmaenmawr axe factories, differences in mineralogy were observed that he felt accounted for the better fissility of stone from some parts of the outcrop (RCAM 1956).

Group XVIII

In recent years a team from the Open University has researched new, non-destructive laboratory techniques for analysing and provenancing both stone implements and glacial erratics.

These challenges have been taken up in a handful of papers by Williams Thorpe *et al.*, and Jones & Williams Thorpe, between 1999 and 2003. Although these studies do not directly compare any grouped flaked implements with polished ones, they have demonstrated the success of employing non-destructive analyses to acquire extremely detailed data on lithic composition which can be applied to address questions about the potential relationship between specific lithic mineral components and the artefactual forms they took when worked.

In particular, the examination of a discrete number of Group XVIII implements from eastern and southern England, suggests 'preferential use of one type of Whin Sill material (the high Zr rocks), at least in the relatively small sample...studied, may reflect the selectivity of glacial processes in transporting rocks of particular hardness or joint spacing' (Williams-Thorpe *et al.* 2003:1263). This seems to hint that Zirconium acts as a hardness 'protector' mineral within this grouping in a similar way to that suggested for epidote and Group VI. If may, for example, inhibit the breakage of 'far-travelled' axe-hammers.

This developmental laboratory work is important because it is one of the first investigations to have provenanced glacial erratics using geochemistry as opposed to petrography (Williams-Thorpe, Aldiss *et al.* 1999). Most importantly, these researchers are also under-

taking exhaustive literature searches, helping to build up a clearer understanding of the areas in which superficial deposits may best repay future investigations for their value to both archaeology and geology.

Discussion

In spite of much campaigning over many years to have re-cycled materials examined to the same laboratory standards as the stone implements, there is still reluctance to recognise the serious potential of that resource in its contribution to an understanding of lithic procurement patterns in prehistoric times. That such research can also refine an appreciation of regional glaciation and other geological processes has been demonstrated by the Open University team, which is an obvious and welcome exception to this statement.

Unfortunately, the quality of data generally available to archaeologists on the background geology to the stone axe trading question is not of a high order. Consequently there still a strong belief among the archaeological public that the detailed distribution and paths of all ice-carried erratics are by now well known or can be reliably predicted. However, although erratics have undergone little petrographic investigation, such detailed work as has been undertaken seems to demonstrate that a wide repertory of far-travelled stones was available to the prehistoric implement-makers, even outside those areas conventionally believed to have been glaciated (e.g. Williams Thorpe, Aldiss *et al.* 1999).

Time and again, in explanations about the likely provenances of axes randomly found or excavated, the accredited existence of a distant 'factory' is given priority over any reasonable deduction that might be made from first-hand observations about the form of the artefact. Consequently, the existence of partial patina or ice-scratching, like that seen on the artefact from Lynch Farm in the Nene Valley, tends to be overlooked (Briggs 1979; 1989:29–30, fig.5; 2009, FIG.13). This problem was also mentioned (Briggs 1989:29) in relation to discussion about the provenance of a Group VI axe from Alveley in Shropshire, in which whereas there was a possibility that the stone had been fashioned from local erratic, the accomplishment of its craftsmanship swayed the discussants into conviction that it was a 'factory' product (Chitty 1970). In cases such as this, it would in future be useful, if it not in reality vital to a better appreciation of the problem, were provenancing data to be made available on local re-cycled material for comparative purposes.

If it could be satisfactorily demonstrated that the implement workshops of the British-Irish uplands really were places central to organised production involving the long-distance movement of goods, to refer so consistently to the factories at the expense of all the other lithic resources available during later prehistory would seem reasonable and excusable. But the petrographic evidence suggests how the sectioned polished axes are generically freer of epidote than factory flaked blanks on the one hand, and that flaked epidotic prehistoric implements become increasingly uncommon with distance travelled from exposure on the other. Surely, the scientific community ought to be concerned about problems of this sort, and there ought to be pause for thought to more fully assess and investigate, before continuing to exclusively promote the theory of trade?

If a dichotomy really exists between the petrographs of flaked, largely upland-produced implements, and those polished implements which tend to be found at some distance from the factories believed to have produced them, more detailed petrographic descriptions now need to be published, or the nature of the relationship between polished and flaked implements will continue to remain elusive. More exhaustive research on this variable petrography should lend greater credibility to and will strengthen an understanding of the 'groupings' in relation to, or in revision of those provenances established by the Southwestern Museums Implement Petrology Committee over half a century ago.

Conclusions

Arguably the most important problem yet to be addressed in British-Irish later prehistoric stone axe studies is that of establishing how far natural, rather than human agency affected the form, efficacy and distribution of the implements.

From the limited information presented here, it has been argued that there is now strong evidence for proposing that the flaking and polishing of stone implements is most likely controlled by inherent mineral determinants within the composition of the implement. Although first suggested thirty years ago from first hand observation by the petrologist W.A. Cummins, this line of inquiry still remains largely unexplored.

It is important that when proposing or promoting theories of human behaviour, these

should be based upon secure evidence, the data quality of which is agreed among all members of the investigating community.

This question of data quality must therefore be addressed urgently and should underscore all future investigational strategies aimed at provenancing lithic implements. There is clearly a need to resolve an objective research strategy and establish working standards for all aspects of lithic implement study and related evidence development. Re-cycled stone needs to be afforded greater parity with the implements in future investigation programmes as a research priority.

The surviving records of implement petrographic sections (as well as information deriving from geochemistry or other investigative procedures) should form the core of any database, whether developed and available manually or online. This should be the starting point for attaining a sound basis for future lithic provenancing studies.

Future arrangements that may help improve communications among scholars concerned with lithic studies ought to include the regular circulation or publication of mineral descriptions for implements submitted to the Implement Petrology Group or its partners; thin-section archives should be centralised and there needs to be more open discussion of grouping definitions. Finally, little will be learnt of prehistoric behaviour patterns if any related investigation is pursued in ignorance of *all* the lithic resources and of any mineral differentiation in petrographic definitions within 'groupings' which could lead to ambivalence of interpretation. Without these, the outcomes of so many diverse efforts undertaken on so many aspects of this study over the last century will remain meaningless to posterity.

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Flint axes, ground stone axes and “battle axes” of the Copper Age in the Eastern Balkans

(Romania, Bulgaria)

Abstract

This paper provides a substantive review of evidence for the form, chronology and context of Battle Axes and other flint and ground stone axes in the eastern Balkans during the Copper Age.

Details on the raw materials, chaînes opératoires and morphology on many axe/adze blades demonstrate a complex picture of local traditions set within broader scales of interaction and far wider spheres of influence. Within these complex and overlapping worlds, axes seem often to have been made, circulated and deposited as items of some social or symbolic importance. They were, in fact, one of the media through which wider relations were formed. It is also clear that forms originally made in one material were sometimes emulated in others and that the biographies of individual axes could shape how they were treated and deposited.

The complexity of this evidence challenges simplistic models that seek to account for social and economic change solely in terms of (repeated) indigenous innovation. Instead, it may be better to think of traditions that resolved themselves at many different, overlapping, scales of spatial, temporal and social resolution.

Introduction

In the first half of the 20th century, V. Gordon Childe developed a model of cultural diffusion with a gradient from the Near East to the northern parts of Europe (1928, 1947). Childe was by no means the first in this, he followed a traditional paradigm of European archaeology in which North Africa and the Orient were responsible for the creation and spread of cultural progress. For example, Sophus Müller (1905:19f) used the image of a *"Kulturwelle"*: a cultural wave flowing from the Near East to the Baltic Sea which not only took some time to reach the northern periphery but also lost more of its strength, the farther it went away from the starting point.

With the advent of radiocarbon dating this paradigm came in for heavy criticism. It was possible to show that the prehistoric sequence in many areas of Europe was a consequence of developments that were either autonomous or, at best, parallel to the trends seen in the Near East. Colin Renfrew was in the vanguard of attempts to separate Europe from the Orient (Renfrew 1969, 1973). Emphasising the ^{14}C evidence, he argued for the cultural independence of the Copper Age in South Eastern Europe, highlighting the antiquity of heavy copper objects and the manufacture of gold items in the Balkan region. The cemetery of Varna at the Bulgarian Black Sea Coast was central to that argument, given a prominence that is also reflected in the scientific and wider literature. A recent exhibition of the finds in Germany went under the title *"Power, Control and Gold: The graveyard of Varna and the beginnings of a new civilisation"* (Fol/Lichardus 1988; translation and italics by author). *"Ex Balcanae lux"* had replaced *"ex Oriente lux"* (Todorova 1978:1).

Renfrew's argument remains prominent. However, discoveries over the last few years have led us to question some of its precepts. For example, there are gold objects from 5th millennium contexts in a cave in the Nahal Qanah, Israel (Gopher 1996). The latest discoveries at Tell Brak also demonstrate that large administrative buildings as well as tool and jewellery workshops existed at that time (Oates 2007) which raises the potential for similar discoveries in the 5th millennium layers of other Mesopotamian central places which have not yet been excavated *in extenso*. Not only that, the copper objects from an early 4th millennium hoard in the Nahal Mishmar, Israel (Bar-Adon 1980) are made in such a complex manner that a long antecedent tradition has to be assumed.

These observations suggest that we may

have given an unwarranted primacy to autochthonous models. For example, in spite of ^{14}C evidence which allows different interpretations (Bakker *et al.* 1999), Vosteen (2002) argues for the independent invention of the wheel in European prehistory on no less than five separate occasions. The details of this example are not important here. What matters is that such arguments do not allow for the possibility of communication between neighbouring territories despite a wealth of evidence to the contrary. For example, Klassen (2000:264f, 265 Fig. 141) argues that the gold sheet figures from Varna, Grave 36, show parallels, even in anatomically wrong details, with pictures from megalithic graves in Brittany. He concludes that a direct knowledge of both areas has to be assumed. Equally, Hansen (*et al.* 2004:4) draw the attention to the gold finds from a grave at Pauilhac (Dép. Gers, Gascoigne, France) and find astonishing parallels in the graves of Varna and the Copper Age hoard of Moigrad in Transylvania while Günther (1990) highlights details of style and content linking passage graves in western Germany and *stelae* in the Ukraine. Even though local and internal factors for cultural change should not be underestimated, the importance of far reaching communication networks in the 5th and 4th millennia is stressed by such examples and has to be taken into account when reconstructing a cultural history.

KGKVI: cultural division and state of research

The burial ground of Varna belongs to the "cultural complex" Kodžadermen-Gumelnița-Karanovo VI (KGKVI) which is distinguished by multi-layer tell settlements and massive copper tools and weapons. The ceramic styles however are regionally very varied and are (apart from natural and political borders) the main basis for the division of the complex into cultures (Todorova 1978:138). For example, the Gumelnița-culture is associated with the Lower Danube (Rosetti 1934:6ff), while in the Dobrogea, research has defined the cultural "aspect" Stoicani-Aldeni-Bograd. (Comșa 1963; Dragomir 1970, 1979, 1983; Hașotti 1988–1989). The tell of Kodžadermen (Popow 1916–1918) is occasionally used to describe a group of sites placed in north-eastern Bulgaria while the rich graves of the Varna cemetery justify a separation, perhaps as a distinct "culture" in their own right. South of the Stara Planina, the sixth layer of Tell Karanovo and similar sites are generally

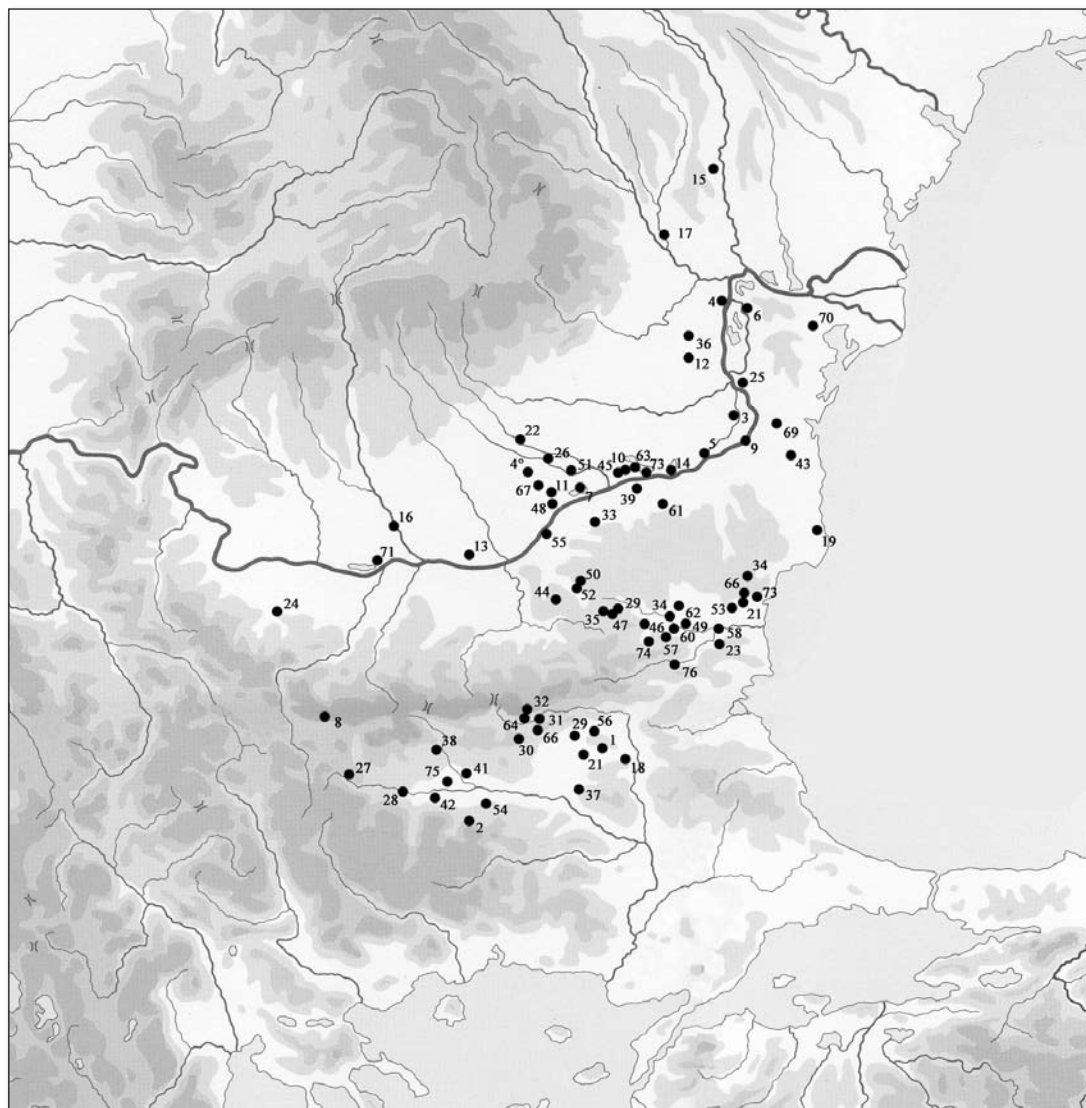
Fig. 1.

Map of the KGKVI complex. Note that a few sites were included for completeness sake even though some scholars classify them as KSBh.

1. Bikovo, west of Sliven, Stara Zagora district, Bulgaria (Detev 1950; 1954; 1960; 1963);
2. Bogorodično, Assenovgrad district, Bulgaria (Detev 1948);
3. Borduşani „Popină“, Ialomița county, Rumänien (Nălbitoru 2003);
4. Brăilța „Vadul Catagăței“, City of Brăilța, Romania (Hartuche 1959; Hartuche/Anastasin 1968; Hartuche/Anastasin 1976; Hartuche/Dragomir 1957);
- 4°. Bucșani, Giurgiu county, Romania;
5. Călărași „Grădiștea Călărași“, Călărași county, Romania (Moscalu 1979);
6. Carcaliu „Vadu Mare“, Tulcea county, Romania (Lăzarcă 1984);
7. Cascioarele „Ostrovel“, Călărași county, Romania (Dumitrescu 1965; Marinescu-Bilcu 1965; Stefan 1925);
8. Celopec „Tell Guinova“, Plovdiv county, Romania (Petkov 1948);
9. Cernavodă, Constanța county, Romania (Schuchhardt 1924; Nestor 1937);
10. Chiselet, „Grădiștea Fundeaca“, Călărași county, Romania;
11. Comana, „Goi“, Giurgiu county, Romania (Berciu 1956);
12. Cireșu, Brăila county, Romania (Sirbu 1980);
13. Crângiu, Teleorman county, Romania
14. Cunești „Măgura Cuneștilor“, Călărași county, Romania (Comșa 1983; 1986; Popescu 1935–1936);
15. Dodești, Vaslui county, Romania (Dragomir 1983);
16. Drăgănești-Olt, Olt county, Romania (Nica *et al.* 1994; 1995);
17. Drăgănești „Tecuci“, Galați county, Romania (Comșa 1963);
18. Drama „Merdžumekja“, Burgas district, Bulgaria (Fol *et al.* 1988; Lichardus *et al.* 2000);
19. Durankulak, Varna district, Bulgaria (Todorova 1983; Todorova 2000);
20. Ezero, Burgas district, Bulgaria (Detev 1948; Georgiev *u.a.* 1979);



21. Ezerovo, Varna district, Bulgaria (Todorova/Tončeva 1975);
22. Glina, City of București, Romania (Petrescu-Dimbovița 1944);
23. Goljamo Delčevo, Varna district, Bulgaria (Todorova et al. 1975);
24. Gradešnica „Tell Kaleto“, Vraca district, Bulgaria (Nikolov 1970);
25. Hârșova, Constanța county, Romania (Hașotti/Popovici 1992);
26. Jilava „Măgura Jilavei“, City of București, Romania (Comșa 1976);
27. Junacite, Plovdiv district, Bulgaria;
28. Kapitan Dimitriëvo „Tell Baniata“, Plovdiv district, Bulgaria (Detev 1950);
29. Karanovo, Burgas district, Bulgaria (Hiller/Nikolov 1997; Hiller/Nikolov 2005; Mikov 1937)
30. Kirilovo (Sveti Kirilovo, Kirimethodievo), Haskovo district, Bulgaria (Bittel 1943);
31. Kolena „Kouljta vodénitza“, Haskovo district, Bulgaria (Georgiev 1948)
32. Kr'venik b. Gabarevo, Stara Zagora district, Bulgaria (Koičeva-Mečeva 1979);
33. Kubrat „Mogila Balbunar“, Razgrad district, Bulgaria (Mikov 1926-1927);
34. Levski „Tell Kaleto“, Varna district, Bulgaria (Margos 1972);
35. Liljak-T'rgovičsko, Razgrad district, Bulgaria (Ovčarov 1963);
36. Lișcoteanca „Moș Filon“, Brăila county, Romania (Hartuče/Anastasin 1976)
- Lișcoteanca „Movila Olarului“, Brăila county, Romania (Hartuče 1987)
- Lișcoteanca „III“, Brăila county, Romania (Dragomir 1979; Dragomir 1983)
37. Madrec, Haskovo district, Bulgaria
38. Mălăești de Sus, Prahova county, Romania (Comșa/Georgescu 1983);
39. Malik Presleveč „Pompena Stančija“, Ruse district, Bulgaria;
40. Malko Tarnovo, Stara Zagora district, Bulgaria (Detev 1960);
41. Manole „Tell Razkopanica“, Plovdiv district, Bulgaria (Detev 1981);
42. Mečkjur near Zlatitrap „Ploska mogila“, Plovdiv district, Bulgaria
43. Medgidia „Moară“, Constanța county, Romania (Hartuče/Bounegru 1997);
- Medgidia „Cocoșe“, Constanța county, Romania (Hașotti 1985);
44. Nevski (Sultan) „Tell Sultan“, Razgrad district,



- Bulgaria (Mikov 1922; Mikov 1933; Gaul 1948);
45. Oltenița „Tell Gumelnița“, Călărași county, Romania (Dumitrescu 1924; Dumitrescu 1925; Dumitrescu 1966);
46. Ovčarovo, Veliko Tarnovo district, Bulgaria (Todorova 1976; Todorova u.a. 1983);
47. Poljanica near Targoviște, Razgrad district, Bulgaria (Todorova 1982);
48. Pietrele „Măgura Gorgana“, Giurgiu county, Romania (Berciu 1956; Hansen et al. 2004; 2005; 2006; 2007);
49. Preslaw „Martviza“, Šumen district, Bulgaria (Radunčeva 1967; 1972);
50. Radingrad, Razgrad district, Bulgaria (Todorova 1982);
51. Radovanu, „La Muscalu“, Giurgiu county, Romania (Comșa 1974);
52. Razgrad, Razgrad district, Bulgaria (Javašov 1930; Catalogue Sofia);
- Razgrad „Tell Hissarlaka (Hissarlaka)“, Razgrad

- district, Bulgaria (Catalogue Sofia);
- Razgrad „Tell Seidol“, Razgrad district, Bulgaria (Catalogue Sofia);
- Razgrad „Tell Goljam“, Razgrad district, Bulgaria (Catalogue Sofia);
53. Reka Devnja, Varna district, Bulgaria (Lichardus/Lichardus-Itten 1993);
54. Ruen, „Mogila Kurtepe“, Plovdiv district, Bulgaria (Kaludova 1966);
55. Ruse, Bulgaria (Georgiev/Angelov 1952; Georgiev/Angelov 1957; Bojažiev 2007; Slavchev 2005; Zlateva-Uzunova/Slavchev 2005);
56. Sadievo, Burgas district, Bulgaria;
57. Salmanovo „Deneva mogila“, Varna district, Bulgaria;
58. Sava, Varna district, Bulgaria (Mirtchev 1960);
59. Sboryanovo Archaeological Park near Russe, Bulgaria;
60. Smjadovo, Varna district, Bulgaria;
61. Sokol, Razgrad district, Bulgaria;

62. Šumen „Tell Kodžadermen“, Varna district, Bulgaria (Gaul 1948; Popow 1916-1918);
63. Sultana „Măgura Sultanei“, Călărași county, Romania (Andrieșcu 1924);
64. Stol't, near Gabarevo, Stara Zagora district, Bulgaria (Koičeva-Mečeva 1979);
65. Strašimirovo (Goljam Aladân), Varna district, Bulgaria (Magos 1973);
66. Stara Zagora „Azmak mogila“, Haskovo district, Bulgaria;
67. Tangiru, Giurgiu county, Romania (Berciu 1961);
68. Targoviște, Targoviște district, Bulgaria (Angelova 1986);
69. Tirgușor „Sitormen“, (Hașotti/Wisoșenski 1984);
70. Trestenic, near Nalbant „L2“, Tulcea district, Romania (Lăzurcă 1995);
71. Vădăstra, near Corabia „Măgura Cetate“, Olt county, Romania (Christescu 1927-1932);
72. Vărăști „Gradiștea Umilor“, Giurgiu county, Romania

- (Comșa 1973);
- Vărăști „Tell Boian-B“, Giurgiu county, Romania (Comșa 1962; 1973);
73. Varna, Varna district; Bulgaria (Fol/Lichardus 1988 with further literature);
74. Vinica, Varna district, Bulgaria (Radunčeva 1976);
75. Yassatepe, Plovdiv district, Bulgaria (Detev 1963; 1976);
76. Zavet, Burgas district, Bulgaria (Mikov 1961).



summarised together as the Kara-novoVI-culture.

This area, from now on called the Eastern Balkans, can be separated from the western part of South Eastern Europe. It is delimited to the north by the Carpathians, to the east by the Black Sea, to the west by the Balkan Mountains and to the south by the Aegean. This is reflected in the archaeological material from the Early Neolithic onwards. The Eastern Balkans are colonized by groups which are characterised by the use of painted pottery, polished stone axes and clay figurines (Karanovo I, Cris). By contrast, the material culture in the west is completely different. The ceramics are unpainted and are decorated instead with the imprints of shells (*Impresso*). Figurines are also absent, while axes are made from flint and are flaked but not polished (Müller 1991: 311ff; flint in this text is analogous to chert and silex (Hauptmann 1999:7ff).

Within KGKVI, extensive excavations have been undertaken since the beginning of the 20th century, but many important sites are published only in preliminary outline (cf. Fig. 1). Detailed information on the nature of settlements and of contexts for the finds are missing for nearly all sites. Overviews are general (Todorova 1982), relatively old (Nestor 1928, 1933; Mikov 1933), or limited to copper finds (Todorova 1981; Vulpe 1970). Graveyards are known from many sites (Todorova 1982) but apart from some exceptions (Comşa 1995; Todorova-Simeonova 1971; Todorova 2002) information is limited or altogether unavailable. Hoards are relatively rare (Nicu/Pandrea 1997: Fig. 6) though a large number of single copper finds may be significant here. Radiocarbon dating shows that with some regional variation, KGKVI started before 4600 and ended between 4200 and 4000 (Bem 1998, 2000–2001; Görsdorf/Bojadžiev 1996; Klimscha 2007).

Axes of the KGKVI complex

In earlier Boian/KaranovoV phases, axes were relatively short, polished and made out of stone (Comşa 1965, 1974, 1975). In KGKVI contexts, they are often significantly larger and are made from a far wider variety of materials. In typological terms, one can differentiate between small ground stone axes or adzes with a rectangular or oval cross-section (Fig. 2, 1–20; Fig. 3, 1–5); small, narrow chisel-like tools (Fig. 3, 6–13); large, polished flat adzes (Fig. 4, 3–6); perforated “battleaxes” (Fig. 5, 1–8) and large, surface-retouched axes made from flint (Fig. 6,

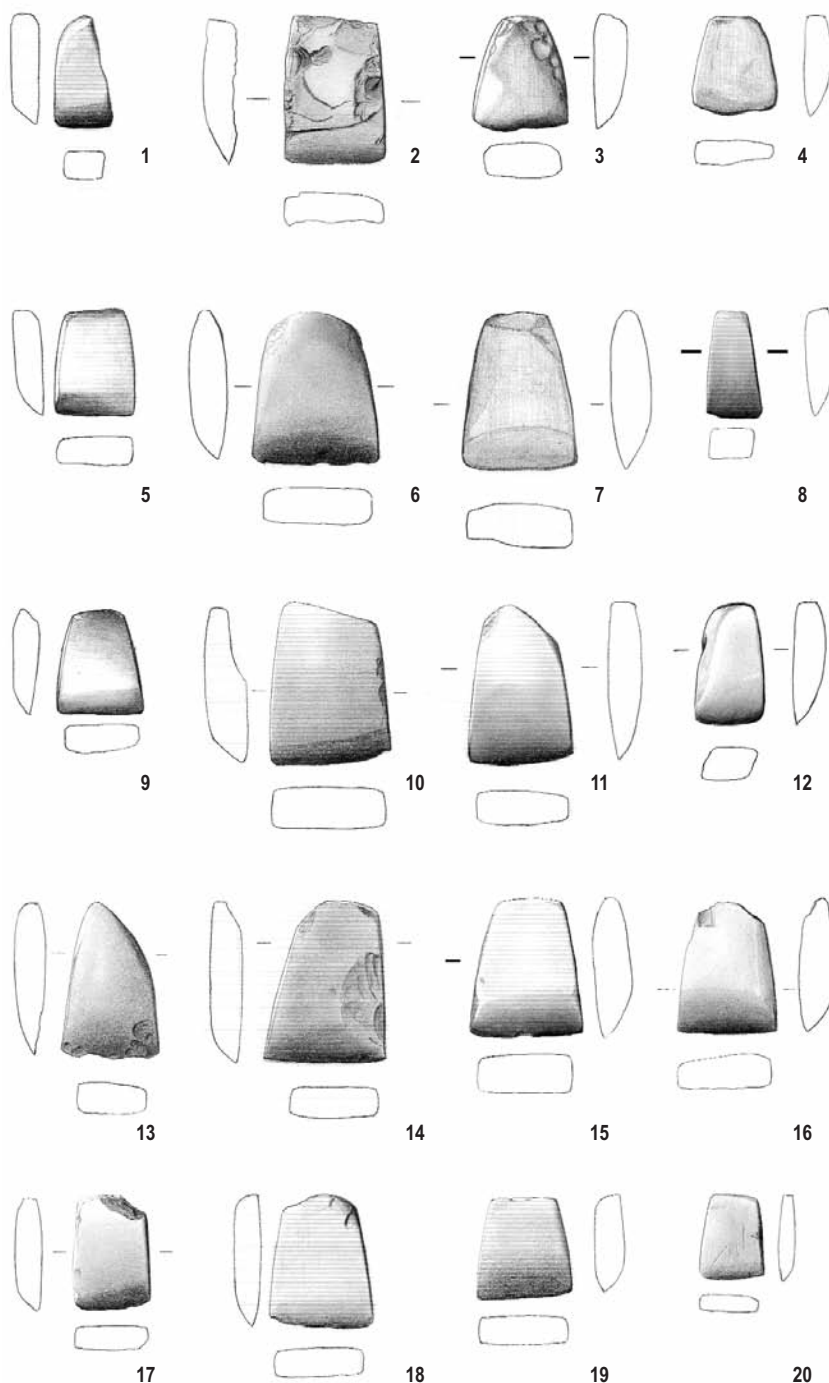


Fig. 2.
Small ground stone axes
and adzes from Pietrele
“Magura Gorgana”,
a settlement of the
Gumelnița-culture.

1–4). This range is complemented by small adzes made from bone; antler axes; copper chisels; flat copper axes and heavy, perforated copper axe-hammers and axe-hoes. Some other forms exist, but are either singular finds or can be better explained as reworked larger pieces. Several shorter, sometimes conflicting typologies exist (Klimscha 2005; Ciută 1998; Comşa 1992; Kănčev 1967; Păunescu 1970; Spinei 1970; Spinei 1971), a more detailed analysis by the author is being prepared for publication (Klimscha 2008).



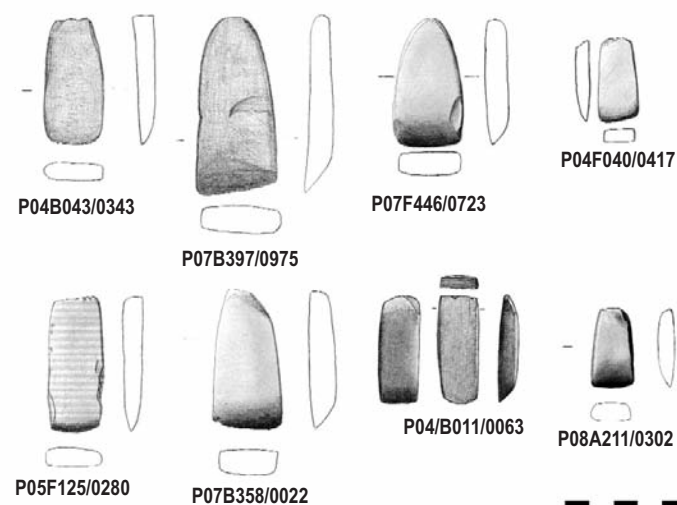
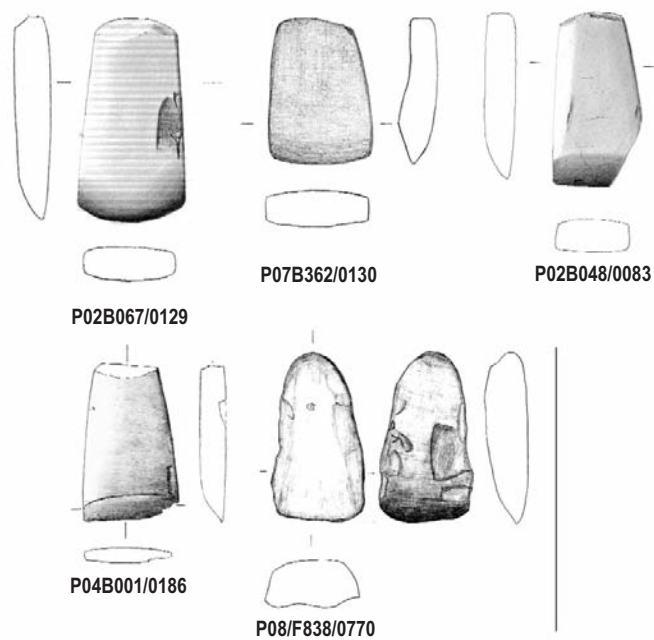


Fig. 3.
Small ground stone axes
and adzes; chisels from
Pietrele "Magura
Gorgana",
a settlement of the
Gumelnița-culture.

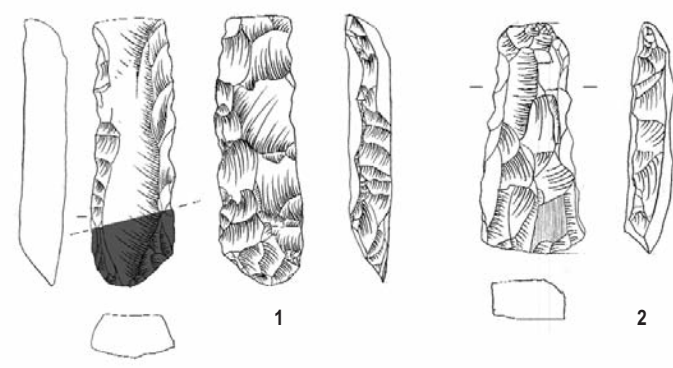
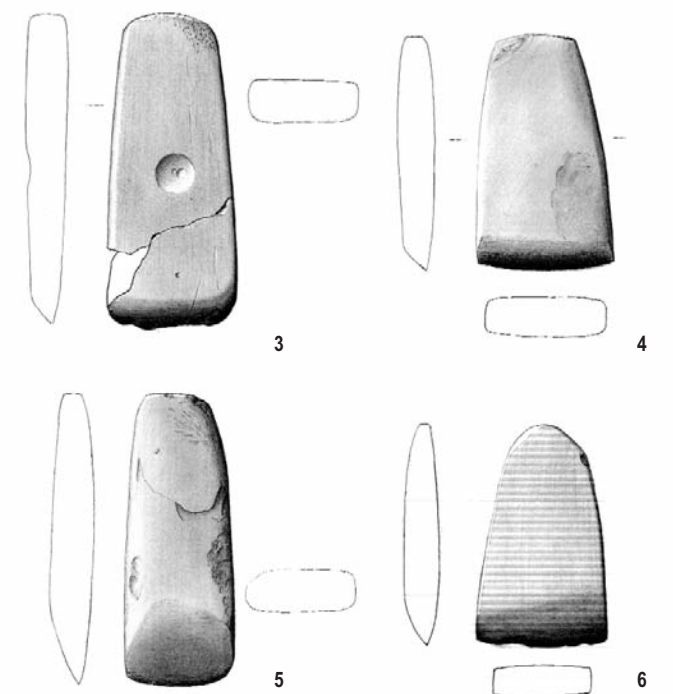


Fig. 4.
Flat adzes from Pietrele
"Magura Gorgana",
a settlement of the
Gumelnița-culture.



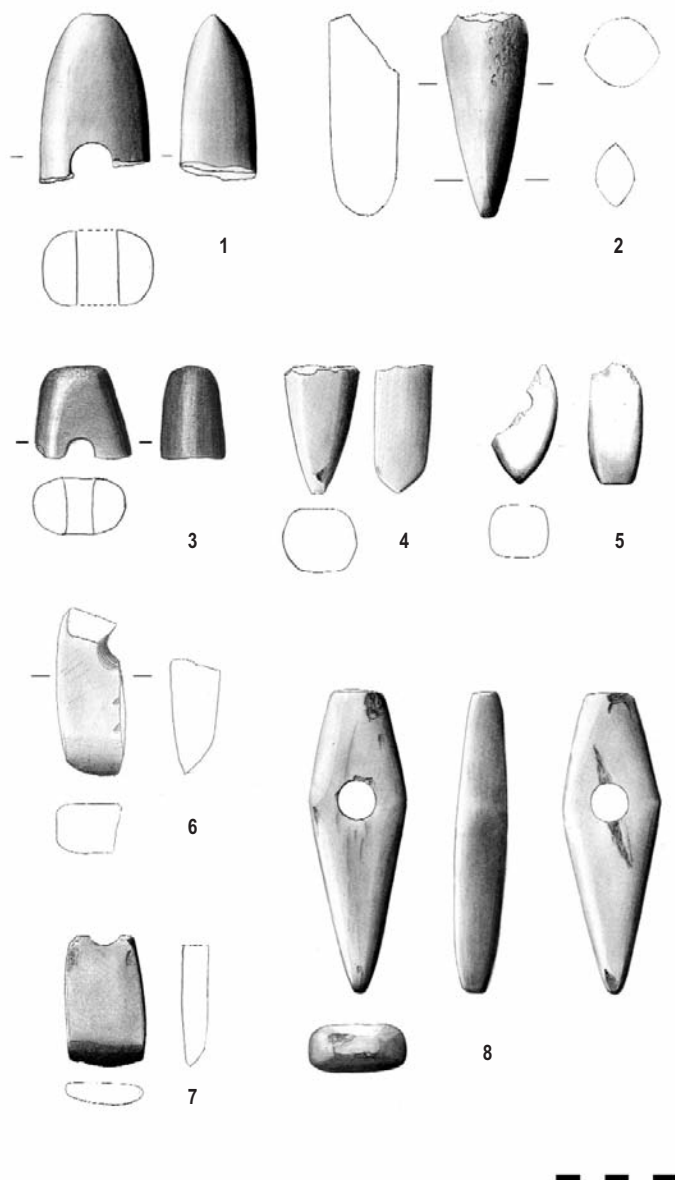


Fig. 5.
Battleaxes from Pietrele
"Magura Gorgana",
a settlement of the
Gumelnița-culture.

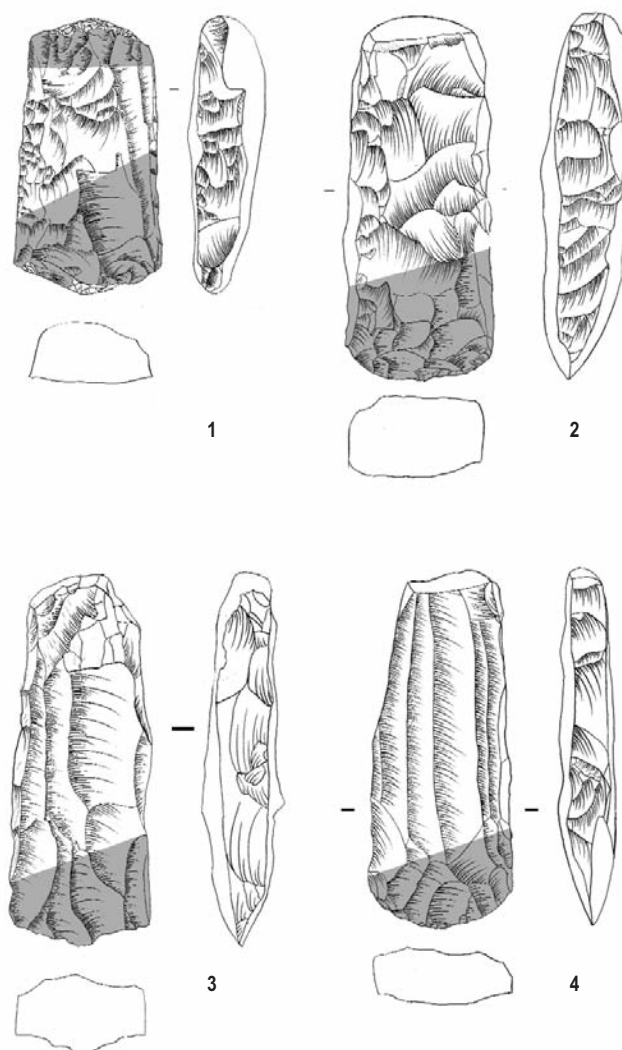


Fig. 6.
Flint axes from Pietrele
"Magura Gorgana",
a settlement of the
Gumelnița-culture.



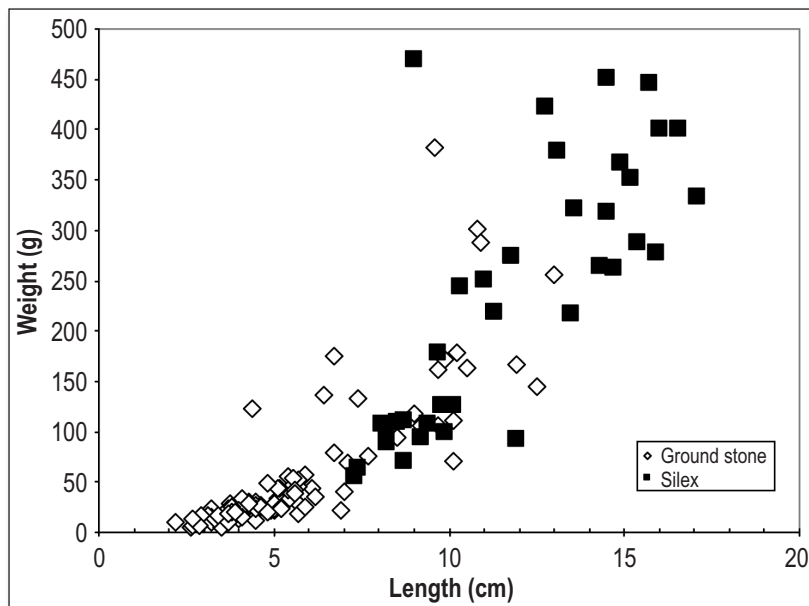
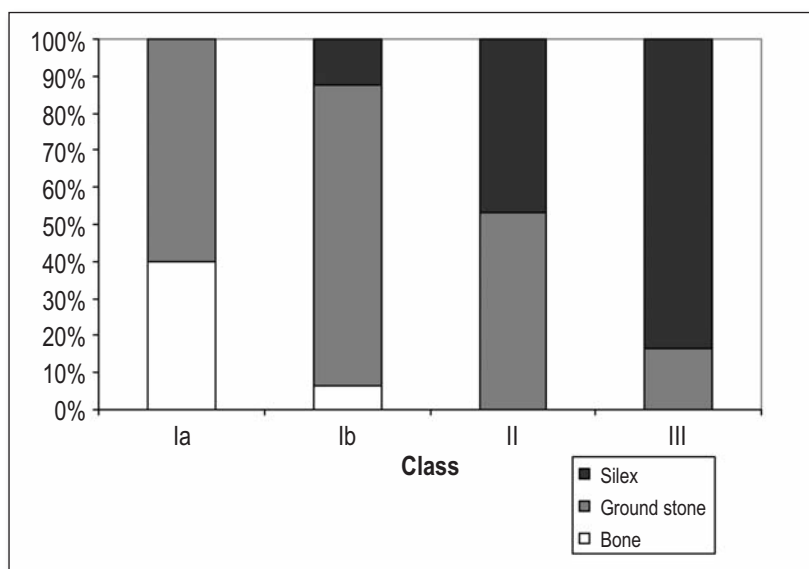


Fig. 7.
Ratio of weight and
length of axe heads
from Pietrele
"Magura Gorgana",
a settlement of the
Gumelnița-culture
(n=165).

Looked at in detail, the stone axes are patterned in a number of interesting ways. To begin, it is striking that those made from flint are significantly larger as well as considerably heavier (Fig. 7) than those made from other raw materials. This is not the result of a more intensive or protracted use of ground stone axes. Instead, it reflects the making of larger axes when using flint and smaller ones when using other stones. This seems to have been a definite choice on the part of the producers of these blades. It involved the careful selection of flint nodules of a size and quality sufficient to allow the working of axe heads which were often more than 15cm long. Not only that, it required that a very different set of criteria be applied to other kinds of stone. In regions where early Neolithic axes were often significantly larger (e.g. Kánčev 1995), the more diminutive forms

Fig. 8.
Ratio of bone, flint and
ground stone on the
classes I-III in Pietrele
„Magură Gorgana”,
Giurgiu county,
Romania (n=311).



associated with KGKVI contexts have to reflect a cultural choice.

Use-wear, morphology and size-range analysis all help to explore some of the choices made during manufacturing, and some of the uses to which different blades were put. Length and weight indices are probably the easiest ways to classify axe blades, and it seems reasonable to work from the basic assumption that large and heavy axe-blades were probably used in different ways to the slender and lighter ones (Winiger 1991). Four classes can thus be distinguished: Class I-axes are shorter than 7cm and can be sub-grouped into those weighing less than 30g (1a) and those with a maximum weight of 90g (1b). Class II-axes have a weight of between 91g and 250g and class III-axes weigh more than 250g and are longer than 14cm (Klimscha 2008).

Certain types and materials are limited to distinct classes of weight and length. For example, bone adzes only appear in classes Ia and Ib, as do the small groundstone axes with rectangular or oval cross-sections (Fig. 8; 18). At least some of these pieces were used as adzes in an antler-sleeve. The chisel-like axe heads are also found in class I only and were probably used similarly. Several pieces show traces of extended modification, for instance the remains of a perforation, that demonstrate that these small axe heads were not in all cases primary products, but made from fragments of larger axes (Fig. 5, 6–7). A group of flat axes made from groundstone and flint can also be placed in classes Ib and II. For some of the pieces made from flint (Fig. 4, 1–2), use-wear analysis indicates that they were constructed from significantly larger, damaged axe heads while it seems that the pieces of groundstone were primarily produced in that size. The relatively thin shape and the form of the cutting edges hints at a use as an adze. When the weight of the antler sleeves (ca. 80–150g) is added to the class I-axe heads (20–90g), it is similar to that of class II-axes (ca. 110–270g), but still significantly less than that of class III-axes. Therefore the only functional difference between class I and class II-axes is the width of the cutting edge, but both are significantly lighter than class III-axe heads.

What function can be assumed for the class III axe heads? Only copper and flint examples are found in class III. Traces of gloss on all four sides of those made from flint hint at hafting as an axe (Arnold 1989). Some cutting edges and the cross-sections of flint axes also resemble those seen on copper axes, suggesting a similar interpretation for both types. As various authors have pointed out, one of the main pur-

poses of early copper items was social display, and it may be prudent to extend this role to examples made of flint (e.g. Vandkilde 2007:55). However, since flint axes are extremely effective at cutting wood (Jørgensen 1985), their practical potential should not be underestimated. Perhaps it can even be argued that the prestigious meaning of large flint axes derived from their effectiveness. In KGKVI settlements only ca. 10% of all axes can be assigned to class III and nearly all axes from that group are made from flint. Apart from their use as tools and prestigious items, flint axes also featured in acts of ritual or otherwise formal deposition, a good example being the complete and ‘mint’ flint axe incorporated into the wall of an oven structure in Pietrele “Magura Gorgana” (Fig. 16).

From a technological perspective, the perforated axes (“Battle Axes”) are a very distinct category. Perforated axes in KGKVI settlements are marked by their flat and narrow shape and have perforations ranging between 1.1cm and 2.2cm. Basically a pentagonal shape with curved flanks can be distinguished from a variant with parallel flanks. Zápotocký (1996:174) proposed a detailed typology for Southeastern Europe, comprising seven types of Battle Axe (Traian, Lenyel, Ruse, Mortačenov, Konyár, Fényeslitke und Zaminec). The variant with parallel flanks would correspond to the Traian type, while his Ruse type resembles the pentagonal variant used here. Use as a working axe is quite unlikely because of the fragility of most pieces. Perforated axes were nevertheless used as the many fragments and the traces on the cutting edges clearly demonstrate. However their function must have been different from the non-perforated axe heads. Perforated battle axes are also found in rich graves in Varna (e.g. grave 4: Fol/Lichardus 1988:53 Fig. 23; grave 43: Fol/Lichardus 1988:59 Fig. 29) as well as in the famous hoard from Karbuna (Sergeev 1963). They would be perfectly suited for personal combat as has been suggested for similar Central European and Anatolian pieces by several authors (Winiger 1999; Schmidt 2002). Their cutting edges tend to be either quite narrow or even pointed and it is possible that some saw use as a “piercing mace” (Åberg 1918).

This variety in the form of axe heads, and in the pattern of their development over time, sheds important light on the networks of internal and external relations that structured the KGKVI complex. Two examples bring the complexity of these networks into focus: flint axes and battle axes, both of which are contrasted with contemporary copper axes of similar shape.



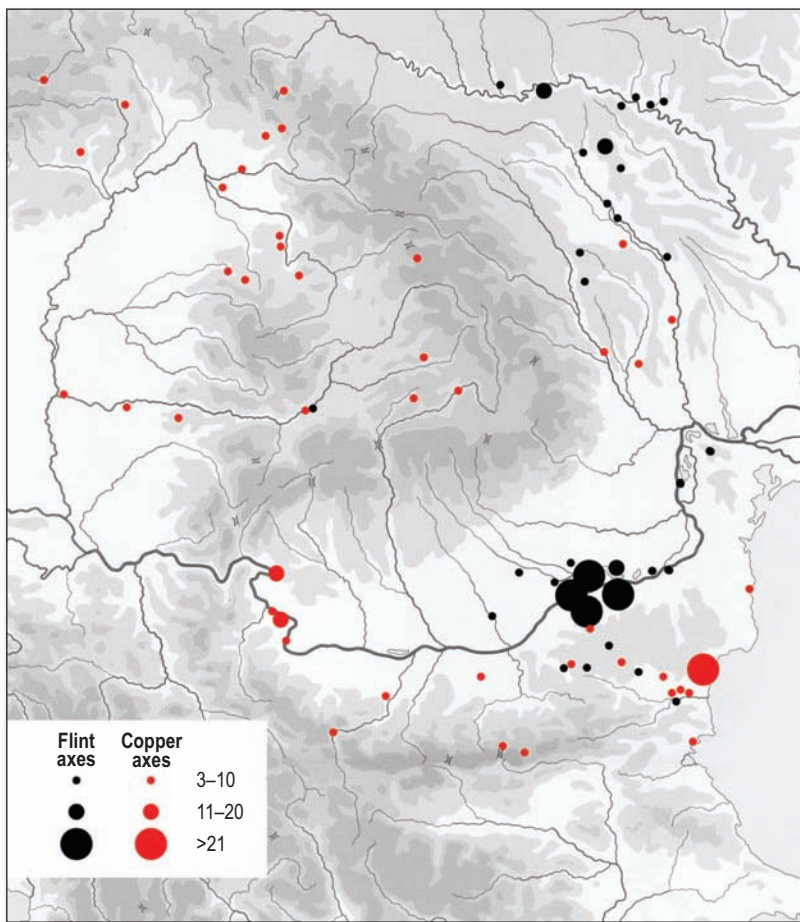
Fig. 9.
The flint axes’ „life“:
Examples of the complete
and fragmentary axes
in Pietrele „Magura
Gorgana“, Giurgiu
county, Romania.

Production and distribution of flint axes

Flint axes are found in considerably higher numbers at sites near the Danube than in those in the *hinterland* (Fig. 10). On-site production has up to now been detected only in the settlement of Căscioărele (Marinescu-Bîlcu 1965). Generally the flint is described as “special” (Comşa 1973–1975). The size of many axes is larger than would have been possible using surface deposits, so an unknown flint mine has to be assumed (Lech 1991). Such high quality flint was also used to produce ‘superblades’ of more than 20cm in length (Manolakis 2002).

Particular stages in the manufacture of axes can often be determined by macroscopic

Fig. 10.
Distribution of flint axes
and copper axes in
South Eastern Europe
between 4500–3800 BC.



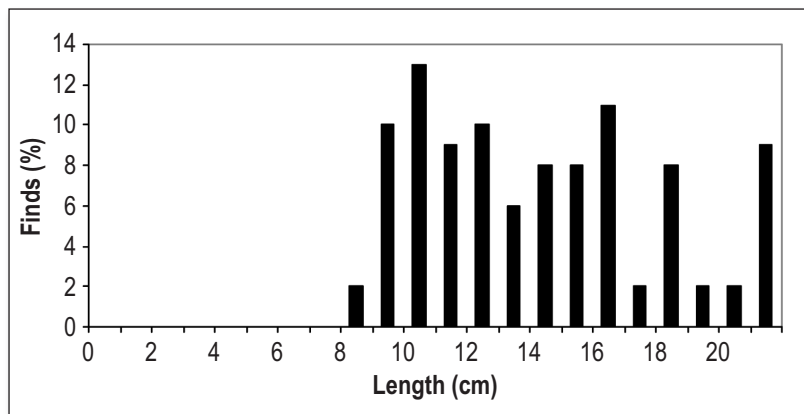


Fig. 11.
Histogram of the
maximum length of
KGKVI flint axes
(n=100).

Fig. 12.
Stone axes from the
„lower, burnt central
house” from trench F
in Pietrele „Magură
Gorgana”.

inspection. Some pieces show the negative scars of blade production on one of their principal faces (Fig. 6, 4) and the hammer marks on many axe-butts are analogous to those commonly found on flint cores. On other axes, a ventral side can still be identified (Fig. 12, left column, 4th position from above), indicating that they were made from very long and thick flakes, probably originating from the preparation of nodules to cores. It has to be concluded that ‘superblades’ and axes are also part of the same *chaîne opératoire*: After the production of blades, larger prismatic cores were then modified into axe heads. These axes were shortened with every repair and sharpening of the cutting edge which explains the length variation. Once an axe had become too short for hafting, its use changed. The minimal length of KGKVI flint axes was ca. 9cm (Fig. 11). Shorter pieces often have a blunt “cutting edge” and were used for hammering (e.g. Fig. 9, central position). The modification into scrapers is also known as well



as the use as raw material for small tools (Fig. 9). Beyond limited areas of deliberate and incidental polishing on some cutting edges, flint axes are never ground.

Flint axes are found most often in layers with burnt houses. The collapsed roof of a house in Pietrele sealed the inventory of the household and seems to be complete (Fig. 12). Seven persons died when the burning house collapsed and buried them beneath the rubble. Inside the house, nine large axes made from flint were recovered, along with another twelve smaller axes and five axe fragments. This amount of axes is rare inside Neolithic or Copper age houses. The best comparisons for such high numbers are found in some of the lake dwellings in southern Germany and Switzerland (Schyle 2006), which would mean that terms of preservation are mainly responsible for the quantity of finds. However on sites of the Cucuteni-Tripol'e culture it can be demonstrated that the number of axes can also vary drastically within the houses of the same settlement. In Drăgușeni (Marinescu-Bîlcu/Bolomey 2000) and Tîrpești (Marinescu-Bîlcu 1981) 50% of the houses had no axes found inside them while 45% of the households possessed one to three axes and six or more axes were found in 5% of the houses. Comparable studies for KGKVI houses do not exist yet. Detailed data about the find contexts are present for only very few axes. It seems certain however, that complete pieces are found almost exclusively inside houses. Only smaller axe heads are sometimes found in the alleys of tell settlements (Fig. 13).

Axes of all types are often found in KGKVI graves. In Varna, battleaxes and copper axes tend to dominate while from the Lower Danube a grave find of a flint axe is also known (Comșa 1962). Flint axes are missing in Varna but 'superblades' are found in several of the very rich graves in the Varna cemetery (Fol/Lichardus 1988:181ff.). Both superblades and flint axes were spread within KGKVI but the latter are scarcer south of the Danube. In fact, certain materials were preferred over others when producing very large axe heads. In the lower Danube area, large axe heads are made mostly from flint, while copper axes cluster around Varna and east of the Iron Gates (Fig. 10). If the common interpretation of copper axes as prestigious items is accepted, then this disproportion would mean that large flint axes have to be understood in a similar manner. The exclusivity in the distribution and the differing centres of flint axes and copper flat axes could mean that both were competing symbols for



the demonstration of prestige in KGKVI society. During the 5th millennium BC, status was shown along the lower Danube via the possession of flint axes while along the Black Sea coast, copper axes more commonly played that role.

Regional patterning suggests some of the conditions under which axes were distributed/circulated. Like the only known workshop, the greatest concentrations of axes are found on sites with a direct connection to the Danube. Significant numbers are also found on sites which either have an indirect link to the Danube (e.g. they lie next to a tributary) or to the Black Sea. Sites without such connections,

Fig. 13.
Stone axes from the
alleys from trench F
in Pietrele "Magură
Gorgana".

Fig. 14.

Distribution of four-sided flint axes, copper axes and jade axes of the type Bégude in Europe between 4500–3800 BC.



even substantial settlements, usually have only a limited number of axes. Tangîru, for example, is one of the biggest tell sites in the KGKVI complex and was extensively excavated. Yet there were only two flint axes published (Berciu 1956). It therefore seems plausible to argue for a hierarchical system of distribution tied closely to the river as a medium of communication. Tell sites along the Danube exercised a degree of control over the flow of axes along the river and from there to sites along tributaries and the Black Sea coast. Sites with limited access to rivers were altogether marginal to this network, receiving far fewer axes.

Beyond these regional trends and on a European scale, flaked flint axes with a four-sided cross-section are characteristic finds not only in the KGKVI Complex but also within the Cucuteni-Tripol'e Culture and in the early TRB Culture (Fig. 14). ¹⁴C dating establishes the contemporaneity of late KGKVI with the older Cucuteni-Tripol'e culture (Wechler 1994:13) and with the Pikutkowo phase of the Eastern Group of the TRB Culture (Midgley 1992:495–501; Bronicki *et al.* 2003; Kruk/Milisauskas 1977, 1981; Koško 2003) in the 42nd and 41st century (Klimscha 2007). During that time, four-sided flint axes are distributed only in the aforementioned cultures which strongly suggests the diffusion of ideas and perhaps materials, though more work on raw materials and technology is needed if we are to take this suggestion any further.

The Eastern Balkans and the Baltic Sea region are not linked via the Danube but

instead by the course of the rivers Prut, Siret, Dnjestr and, at last, the Vistula. Even after the KGKVI complex disappears (ca. 4200–4000 BC), for reasons that remain hotly debated (Gimbutas 1994; Häusler 1995:92f; Lichardus & Lichardus-Itten 1993, 1995; Link 2006; Meskell 1995; Parzinger 1998; Todorova 1998), flint axes are still found from Moldova to the Baltic Sea. This “eastern connection” can be separated from another distribution cluster that follows roughly Childe’s classical route via the Danube, and is characterised by copper axes (both flat axes and perforated examples). Chemical analyses demonstrate the important role that the Bulgarian mines, especially those at Ai-Bunar (Černych 1978), had for the distribution of copper axes in the 5th millennium (Černych 1991). Prestigious copper items were exchanged in local networks along the great rivers and eventually reached the Baltic Sea (Klassen/Pernicka 1998). The distribution ignores cultural boundaries and connects regions with a flourishing copper industry with the Mesolithic periphery in the north of Europe. Klassen (2000, 2004) showed the importance of this copper for the beginning of Neolithisation in Northern Europe (around 4000BC) where the desire for such prestigious items finally makes local communities adopt the Neolithic way of life. On a broader scale, and from the middle of the 5th till the first half of the 4th millennium BC, the distribution of copper items and large silex axes are largely exclusive. They overlap, however, in the Eastern Balkans, where I argued for a model of local competition: most

settlements either have large axes made of copper or of stone but rarely both types together. Significantly smaller working axes are present in all known settlement sites suggesting that the larger axes are functionally unnecessary. Therefore it seems justified to interpret the large silex and copper axes not only as tools but also as items of social significance. The exclusiveness of either copper or silex that is used only for axes of that size suggests that both materials are used to communicate the same or a similar concept of displaying prestige and one could also think about social constraints that enforce the use of only one type of prestigious axe. Similar developments can be seen in several archaic societies (e.g. Lévi-Strauss 1974; Volti 1995).

In that regard, it is also striking that both copper and large flint axes reach the north at approximately the same time. Large flint axes with a four sided cross-section appear in the Lower Danube at around 4700/4600. The Cucuteni-Tripol'e settlements take over this habit from around 4400 BC. They then appear in the South Eastern and Eastern TRB Cultures around the 42nd century BC. The first pieces in the Northern TRB Culture are found in Siggeneben Süd (Meurers-Balke 1983) which can be dated to 4100/4000 (Meurers-Balke/Weniger 1994) or around 3800 (Klassen 2004: 209–211). Thus within half a millennium a sign for social prestige was transported more than 1500km as the crow flies and transformed in its meaning. Most of the axes known from the TRB milieu were deposited in hoards which were convincingly explained by Rech (1979) as cultic sacrifices to a supernatural being in the bogs and put into the myriad of fertility cults as described by Frazer (1911–1915).

Flint axe deposition clearly survives the end of tell settlement in Southeastern Europe. After 4000 BC, large, four sided axes made from flint are a common trait of both TRB and Cucuteni-Tripol'e Culture assemblages. In fact, it seems, as if in their later phases these cultures become more similar in their material expression (Dumitrescu 1955; Videiko 2000): For some regions, a direct contact between the Cucuteni-Tripol'e and TRB Cultures can be proven already (Libera 1982; Bronicki *et al.* 1988) and when mapping the Cucuteni-Tripol'e ceramic style (Kempisty 1968:378 Fig. 2) it becomes clear that the border between both cultures was more or less permeable. The two hoards from Kisliškogo in the region of Tomašpolskij, Ukraine, illustrate this quite well. According to Makarevič (1964: 212) the 34 thin-butted flint axes found in these hoards, with lengths of 14–19cm, were made in

a very similar manner to “Nordic” axes. The composition of the hoards could also be compared directly with known TRB axe hoards, reflecting the import of certain axes and also of ritual knowledge about the protocols for making offerings. These patterns underline the cultural proximity between both regions. This contact between the Baltic and the Pontic Sea can be made visible with the mapping of four-sided silex axes during the complete 4th millennium B.C. and concludes with the formation of the Globular Amphora Culture which extends in exactly that region.

Taking these communication systems into account, it becomes clear why the best parallels for depictions in Western German megalithic graves are found in the Ukraine (Günther 1990). The flint axes demonstrate that an intensive communication existed between both regions. The early evidence for wheels in Schleswig (Zich 1992) and the Caucasian Majkop Culture (Trifonov 2004) can also be connected in that way and make it necessary to discuss the emergence of wheeled vehicles again, because such networks would allow rapid transfer of innovations like the wheel as is suggested by the ¹⁴C dates.

Perforated Axes

Perforated axes play a different role in European Prehistory. The earliest examples occur in Early Neolithic sites of the Körös-Criş-Culture (Zápotocký 1996:1ff). During the Copper Age, however, more distinctive perforated axes appeared that were often ill-suited or impractical for traditional tasks such as woodworking. We usually group these together in the category ‘Battle Axe’.

The earliest battleaxes in the Eastern Balkans appear during the Karanovo V-Boian phase, for example in Slatino, which precedes the KGKVI complex (Chohadzhiev 2006:Fig. 50, 1.3–4). Some finds from the Precucuteni contexts from Tîrpeşti (Marinescu-Bîlcu 1981:Fig. 47, 5.7–8; Fig. 145, 1–3) are also contemporary. In the tells of the KGKVI complex, it is mostly fragments that survive, although finds of more or less complete pieces are not uncommon, for instance in Goljamo Delčevo (Todorova *et al.* 1975), Ruse (Bojažiev 2007) or Pietrele (Fig. 5, 8). At Varna, several rich grave inventories included battle-axes (Fol/Lichardus 1988:194 catalogue number 7 (2)). Perforated battle-axes are also known in the early Cucuteni-Tripol'e Culture (Marinescu-Bîlcu/Bolomey 2000:Fig. 49, 1–3.5.7–8; Dumitrescu 1954:Fig. 21, 1.3.9.



10.12), in the Vinča Culture (Draşovean/Luca 1990) and the cemetery of Zengörvárkony, Hungary (Dombay 1960; Zápotoký 1986).

In Central Europe, similar axe types appear between the 41st and the 39th century BC (Zápotoký 1996:39). The earliest pieces are found within the *circum alpine* lake dwellings. During the 4th millennium, stone battle axes are still produced in the Eastern Balkans, a good example being the axe from Grădiştea-Călăraşi, belonging to the Cernavodă-I Culture (Moscalu 1979:394 Fig. 5, 1). They are also known from neighbouring regions. In the Salcuţa/Krivodol complex of Western Bulgaria (Todorova 1982: Abb. 47; Radunčeva 1976:Taf. 44, 8), in the Coţofeni-Culture of Transsylvania (Ciugudean 2000:Pl. 120–124), in Hungary in the Tiszapolgár- and Bodrogkeresztúr-Cultures (Patay 1978: 39) and in the Eastern Alpine region during the Lengyel Culture until the phase Lengyel III (Zalai-Gaál 2002, 2004, 2005).

Perforated copper axes (“hammer axes”) on the other hand are centred around the tell sites of Southeastern Europe and the Carpathian Basin with a very thin spread toward the north (Klassen/Pernicka 1998). Thus while in Southeastern Europe and the Carpathian Basin a long parallel development of stone and copper types existed, each type spread individually into the periphery. Perforated copper axes are passed on mainly inside and around the Carpathians while stone battle axes appear across a much larger territory (Ebbesen 1998; Grisse 2006; Zápotoký 1996). At first, Central European stone battle axes are best seen as imitating both stone and copper battleaxes from southeastern regions (Zápotoký 1996:170ff), but the distinct shapes of the later axes (Types R, D and N; Zápotoký 1996:115ff.). Their shape is completely different from all known copper and stone axes from that region. This strongly suggests that the later battleaxes were not meant to be copies or imitations but on the contrary a very public statement of a different taste.

North-South Relations in the 5th and 4th millennium

From the 41st century onwards, stone battle axes appear along the Danube as well as north and east of the Carpathian mountains. The imitation of four sided flint axes in the Baltic Sea regions corresponds to this development. Both phenomena are rather long-lived and last until the middle of the 3rd millennium. While at the beginning an imitation of early metal axes can be reasoned for both forms, at the latest in the

Fig. 15.
Flint axe from the tell of Cascioarele „Ostrovel” with a cutting edge imitating metal axes (after Lech 1991).



Fig. 16.
Flint axe in *in situ* position inside a wall of an oven in Pietrele “Magură Gorgana”.



4th millennium, independent developments can be assumed. Stone battle axes appear in various shapes that cannot be connected to copper axes but seem to reflect regional preferences. Nevertheless battle axes can be traced as far south as in Norşuntepe, eastern Turkey (Schmidt 2002). The shape of flint axes on the other hand remains more conservative from the North Sea to the Black Sea (e.g. Brandt 1967; Hoof 1970; Gronenborn 1992). Both artefact types therefore connect different regions with each other.

The distribution of very sharply defined types of tools and armaments over several thousand kilometres in prehistoric Europe is not easy to explain. If the objects were indeed used for marking and displaying personal status and prestige, then the distribution would represent the widespread nature of the knowledge or taste for making these statements in this particular way. Such a taste can only have been circulated by personal contact. An applicable model would be to imagine the owners of the axes to be integrated in different gift giving networks (Mauss 2007; Godelier 2008) which involved the circulation of all kind of services, materials and marriage partners (Lévi-Strauss 1949). Such networks need not have spanned the entire area of our archaeological distributions, but may have overlapped one with another in ways that are difficult for us to resolve, leading to the spread of ideas and items over vast distances. The first meeting of the Baruya of New Guinea with white people in 1951 may be taken as an example. The members of the expedition were very surprised to encounter natives equipped with steel axes and machetes which they had exchanged from other tribes that already had contact with white missionaries (Godelier 1982). The new items



Fig. 17.
Distribution of battle axes
and copper axes in
Europe between
4500–3800 BC.

were regarded as extremely prestigious and in the time that followed, the Baruya intensified their salt production to get possession of as many steel artefacts as possible (Højlund 1978, 1981). Very similar is the impact steel axes had upon the Australian Yir Yoront. Axes had an important role in the representation of male virtue and were important in rituals. After missionaries introduced steel axes the old gift giving networks collapsed and men even forced their wives into prostitution to get into possession of a steel axe which was then used to structure new exchange networks (Sharp 1952).

Without suggesting to transfer ethnographies directly into the archaeological contexts, these examples still help to clarify the important role that prestigious items, especially axes, may have played in Neolithic social systems. They also highlight the rapidity with which new items (and with them ideas) pierce such societies, changing patterns of production, exchange and even deposition. The axes of the Eastern Balkans illustrate a pattern of diffusion that was mediated via the Danube and the rivers Prut, Siret and Dniestr to northern Central Europe. Even after the tell sites of the KGKVI complex have collapsed, these artefacts were still circulating and show connections over vast areas in the 4th millennium. The patterning of ceramic styles and flint technologies often reveal the relatively local conditions of the lives of prehistoric communities. The evidence of axes shows that those local scales were set within broader networks and wider spheres of influence. If we are to understand sequences of

material and social change in European prehistory, then we must accept that the dynamic for change probably came from the interplay between these different scales of contact and communication. Local innovations and regional traditions were no doubt important. But with the distribution of certain axe types as background, the scattering of high-status items, complex ornaments and innovations like the wheel becomes much more plausible as being influenced by central regions than as being independent local inventions.

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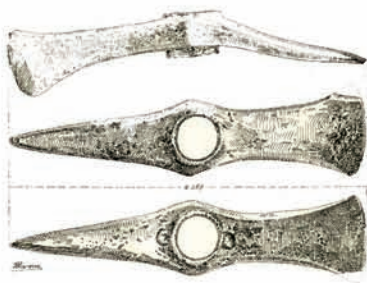
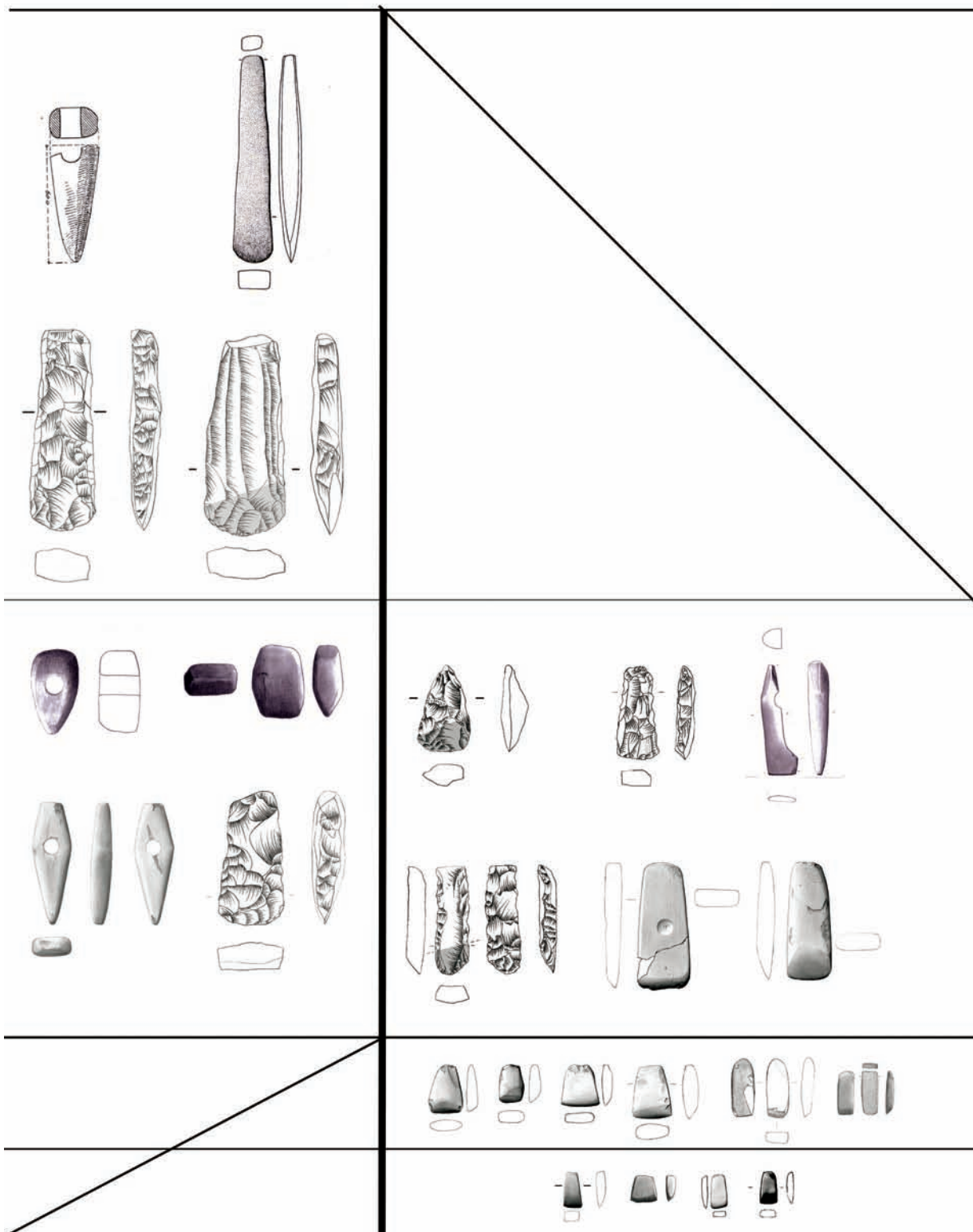


Fig. 18.
Schematic representation
of different types of axes
in the Eastern Balkans
and their relative size.



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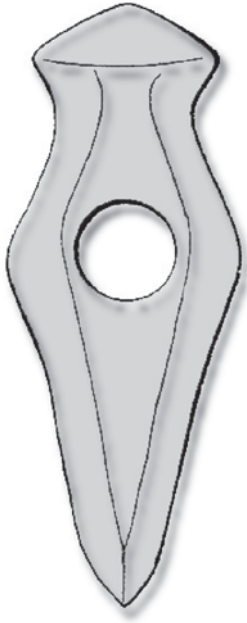
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■■■ Bequests to institutions offer the possibility of posterity; the projection of a name into some kind of future. But nothing is fixed. The passage of an object from one archive to another is a kind of translation, a process in which the details of a story become vulnerable. Connections are lost as objects cross the threshold, and even when they have been safely gathered in, institutions allow a very particular kind of forgetting. Labels fade, the cracked and crystallised gum will only hold for so long, and despite best intentions, a continuity of curatorship is hard to maintain. In no more than a couple of generations, an object can be stripped back down to its essentials, its biography lost or rewritten to meet new disciplinary requirements. ■



●●● *The clamp wasn't tight enough; I guess that's what did it. The blade had just started to bite into the side of the axe when the whole thing started to shake. It seemed like slow motion; the blade froze and before I could do anything, the axe snapped. There may have been a fracture in there already, but that made no difference. All I could do was apologise and reach for the glue. ●*



Stone axes in the Bohemian Eneolithic:

Changing forms, context and social significance

Abstract

This paper provides an outline of the changing forms, context and social significance of polished stone axes and battle-axes during the Eneolithic period in Bohemia. It explores how artefacts of an originally practical function became important objects of exchange and social interaction. This social and symbolic importance shaped the manner in which axes were deployed in funerary rituals. The paper concludes with a brief discussion of how stone battle-axes carried the traditional symbolic importance of stone into the Bronze Age, actively evoking the past itself.

Polished stone tools and weapons in Bohemia – an introduction

Polished stone axes and adzes first appeared in Bohemia in the Early Neolithic with the Linear Pottery Culture (LBK). For the first farming communities, stone axes were of extraordinary importance. Since extensive deforestation made available initial areas for agricultural food production, polished stone tools used for clearance became significant attributes of domestication. Soon after their apparent introduction into the material culture of the first farmers, stone axes and adzes that were primarily produced for a practical function became objects of increased value and prestige (see, for example, the marble adze in the LBK grave in Prague, Fig. 1). The custom of depositing hoards of stone axes or roughouts was also established in this period (Venc1 1973) and there is evidence that some items, such as the massive shoe-adzes or axe-hammers, which were too massive to be of any use, were produced from the outset as prestigious objects.

Stone objects undoubtedly served a wide range of purposes in different spheres of pre-historic society; from use as tools to circulation and display as symbols of social power. The utilitarian and symbolic meanings of many of these artefacts overlapped and shifted with respect to each other over time, often in step with broader socio-economic changes. The purpose of this paper is to follow these changes from the 5th to 3rd Millennium cal BC, tracking the principal forms and significance of battle-axes and stone axes from the Proto-Eneolithic to the beginning of the Bronze Age. The archaeological and absolute chronology of the Neolithic and Eneolithic Period in Central Europe (after Neustupný 1969; Turek 2005) are summarised in the following table.



Fig. 1.
Prague – Liboc –
LBK burial with a
marble perforated adze
(photograph by J. Turek)

Stone artefacts that served as specialised weapons and/or as symbols of power and prestige are present in Central Europe from the beginnings of the Proto-Eneolithic (Neustupný 1998:27–30; Turek & Daněček 2000; Turek 2007; Venc1 1984). Some of these, such as battle-axes, reflect continuities with Late Neolithic tools such as hammer-axes and adzes, which were used primarily as tools and occasionally as weapons. However, the sequence also sees the appearance of new shapes of battle-axes perhaps imitating copper archetypes (Zápotočký 1992), a possibility illustrated by the decorated Corded Ware copper Battle-axe, cast in one piece, together with a decorative shaft (Fig. 5; Lužice, Moravia, see Turek 2007). Other pieces display features which suggest very specific forms of symbolic connotation. For example, the knob-butted Battle-axe, which is of a phallic shape (Fig. 2. – 2, F, K), interpreted as reflecting the articulation of masculinity to certain expressions of (patriarchal) social power (cf. Neustupný 1967; Turek & Černý 2001). This is not unique to Central Europe. Masculine or phallic symbolism is also inferred from depictions and artefact arrangements in some late Neolithic sites in Brittany, such as the “Grand Tumulus” at Mané-er-Hroëk (Patton 1993).

Archaeological Chronology	Average Radiocarbon Date BP	Corrected Radiocarbon Date cal BC
Early Bronze Age, (Reinecke A1) – Únětice Culture	3650	cal 2300/1900
Late Eneolithic, end of Bell Beaker Culture	3750	cal 2300/2200
Late Eneolithic, beginning of Bell Beaker Culture	3950	cal 2450
Late Eneolithic, beginning of Corded Ware Culture	4300	cal 2850
Middle Eneolithic, classical Baden Culture, Globular Amphora, Rinvác, Jevišovice B, Cham, Kostolac	4600	cal 3350
Early Eneolithic, TRB, beginning of the Baalberge phase	4950	cal 3650
Proto-Eneolithic, Michelsberg and Schussenried Culture	5180	cal 3900
Proto-Eneolithic, beginning, Jordansmühl Culture	5550	cal 4300
Late Neolithic, beginning of Stroke Pottery Culture	5900	cal 4700
Middle Neolithic, the last phase of LBK Culture	5935	cal 4750
Middle Neolithic, beginning of LBK Culture (the earliest in Bohemia)	6450	cal 5300

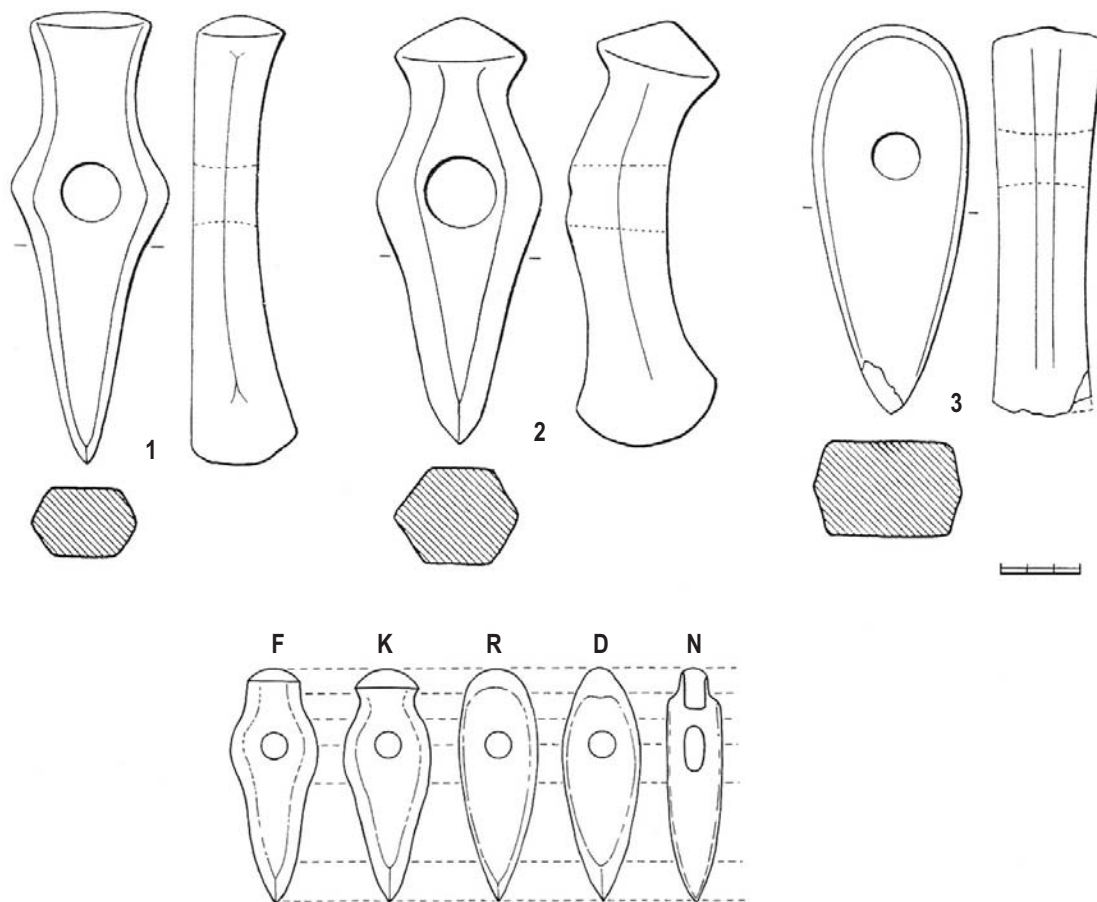


Fig 2.
Types of the
TRB battle-axes
(after Zápotocký 1992)

TRB culture

The TRB or Funnel Beaker Culture saw traditions of stone axe deposition in two principal contexts; burials and hilltop sites. Currently, there are 18 burial sites known with finds of battle-axes in Bohemia, among them several cists and the recently excavated long barrow cemeteries in Central Moravian forested areas, such as Slatinky or Křemela near Náměšť na Hané. Others have come from flat graves that were originally covered by now denuded long mounds, assumed to be the common mortuary construction of the early Eneolithic in Central Europe (Křišťuf 2003). These cases are, however, relatively rare and we should allow that some of our isolated finds were deposited in graves that were subsequently disturbed/destroyed. What evidence we do have suggests that inclusion in burial was largely restricted to complete battle-axes. There are exceptions to this, such as the cutting edge of a Battle-axe from Obrice, but the broader patterns suggest that completeness mattered, and that some were probably deposited with their hafts. There are no signs of intentional breakage of artefacts. Even the Battle-axe from the cremation burial at Kostelec nad Labem was found complete, with no signs

of burning, which means that it was deposited after the cremation of the body, an element accompanying the burial of the ashes. Hill-top sites are another important source of battle-axes. This is mainly due to the visibility of these enclosures, which attracted the interests of antiquarians and archaeologists from an early stage. Unfortunately, the long history of collection means that these artefacts are often missing find circumstances. Good examples of TRB axes from (probable) single period sites include Makotřasy (Pleslová-Štiková 1985) and Prague Baba (Havel 1986).

Following the important work of Zápotocký (1992), it is possible to identify a number of patterns in the form, condition and context of battle-axes in Central Europe. The total number of known finds of TRB battle-axes from Bohemia is 182 (Ibid:233–235,). In the neighbouring region of Moravia there are 137 examples, which have been assigned to five main types: F, K, R, D, N (Ibid:12, Abb. 2, for types see Fig. 2). Unfortunately, we do not yet have a detailed and systematic picture of the raw materials used in the making of these artefacts, though we do have more general macroscopic determinations, which have identified some of the most common rocks to be used as Schist, Amphibolite,



Diabase, Gneiss and Serpentinite (Ibid:144). The largest portion of battle-axes remained intact (over 60% of the F-type of battle-axes). However, over 30% of the total were fragmented in the most stress-prone or fragile part of their perforation. By contrast, the breakage of the cutting edge or front third of the artefacts is rare, represented by less than 8%. There is, of course, no way to determine whether breakage was deliberate, whether it occurred during use or after deposition. However, some are likely to have seen use as hammers which may account for at least some of the breakage patterns that we see. As noted above, the high frequency of intact examples may reflect formal deposition in graves, though this cannot be proven.

Battle-axes are perhaps the first specialised weapons made for fighting, in real clashes and in more ceremonial bouts (see below). The associations that stemmed from their use in this way were such that they were sometimes made in miniature, or emulated in materials such as antler or clay. This was not unique to the TRB. Miniature battle-axes have been found in earlier Stroke Pottery sites, such as Prague – Hostivař (Mašek 1981:9–10, obr. 4:4), where a <4cm limestone shoe-last adze with an unfinished perforation was recovered from a settlement feature. Emulation then, was an established practice and in the TRB, it was continued, examples including the 4cm clay models from Dragsholm (Denmark) and a clay fragment from the hill-top site at Prague Bohnice-Zámka (Hájek & Moucha 1986; Fig. 4). Although full size, the shaft hole of the latter was very narrow, only 7 mm, suggesting that it either attached to a very slender shaft, or suspended as a pendant. Most recently, a 7 cm long clay model of a TRB Battle-axe was found in a settlement feature at Velké Přílepy (central Bohemia (excavation by D. Daněček, see Fig. 3). These finds are perhaps only the tip of an iceberg as they are mainly found in settlement contexts, very few of which have been excavated in Bohemia.

Fig. 3.
Statenice
(central Bohemia).
A clay model of the
TRB Battle-axe
(excavation and
photograph by
D. Daněček).



Stone axe distributions in the Rivnac and Cham periods

The study of patterning in artefact distributions has a long and complex pedigree (cf. Hodder & Orton 1976). Traditionally concerned with the identification of the geographic extent of specific Cultures, work in the past few decades has turned towards the more systematic, even formal, analysis of spatial distributions as a means of exploring the nature and extent of exchange systems (Cummins 1980; Hodder & Lane 1982). Such analyses have not been without their problems; equifinality and a frequent lack of chronological control among them (Bradley & Edmonds 1993). However, the combination of spatial and contextual analysis is crucial for our understanding of polished stone axes in Bohemia, many of them made of a green crystalline tuff, during the later stages of the middle Eneolithic (3300–2900 cal BC).

The largest part of the examined material comes from museum collections built up since the 19th century. These collections tend to be biased towards finished products such as axes, adzes or battle-axes and if they include rough-outs or fragments at all, it is usually only those pieces with distinctive or exceptional features. Raw material samples and working debris, the by-products of artefact production, tend to be absent from most collections. These biases in established collections prompted systematic fieldwalking, undertaken over the past decade or so by this author. This focussed on locations with known Eneolithic sites, and was carried out to determine the spatial structure and associations of axe production and distribution. The results of this work suggest that axe production took place on most of the Eneolithic (mainly Řivnáč period) hill-top sites in Central Bohemia. Raw material was probably transported or traded in the form of roughouts (Fig. 8) or semi-finished axes and worked to completion elsewhere.

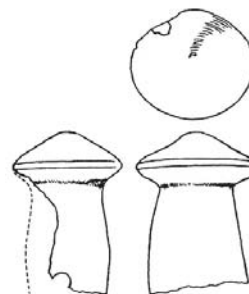


Fig. 4.
Prague – Bohnice,
hill top site Zámka,
fragment of a clay model
of the knob-butted
Battle-axe
(after Turek 2007).

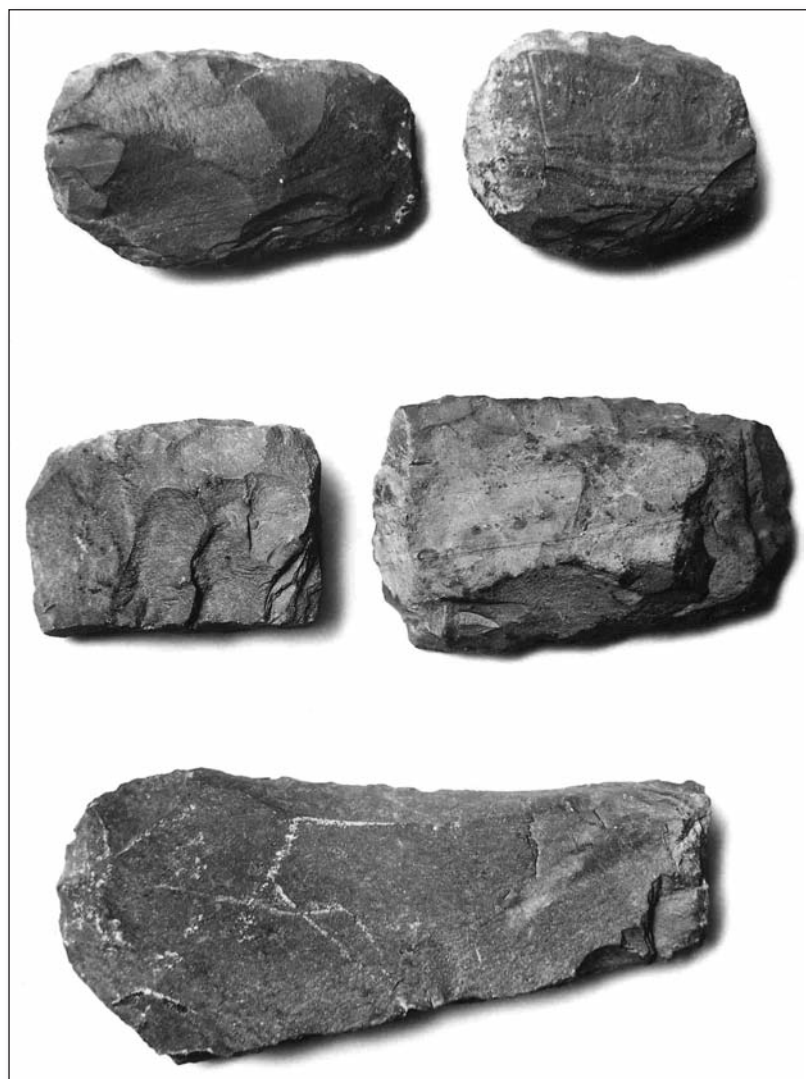
Fig. 6.

A miniature green crystalline tuff axe and relevant roughout from the context of Řivnáč Culture in Central Bohemia (photograph by J. Brožek).



Fig. 8.

Green crystalline tuff roughouts of different forms of axes from the Řivnáč sites in Central Bohemia (photograph by J. Brožek).



Present evidence suggests that the fine grain green crystalline tuff was rarely used as a raw material before the Early Eneolithic and that the greatest quarrying activity took place during the Middle Eneolithic, Řivnáč, period. The quarry containing this raw-material is located on the south-western edge of the Řivnáč territory at Vrané nad Vltavou in Central Bohemia. The outcrop at Vrané nad Vltavou is according to microscopic as well as macroscopic identification probably the only area where such rock appears in Bohemia. Unfortunately the possible traces of prehistoric quarrying on the site were damaged by the construction of a river dam and subsequent erosion of the river bank in the 1960's. As a result, it is only possible to reconstruct the development of possible quarrying activity on the Vrané outcrop by recourse to stratified or chronologically diagnostic artefacts found elsewhere.

There is a limited amount of evidence of earlier Neolithic exploitation of this raw material, and thus perhaps of Vrané itself before the TRB. However, stone might have first been gathered in a pebble form from secondary deposits, so the origins of quarrying at the outcrop are uncertain. The earliest quarrying in Vrané may be more confidently presumed for early Eneolithic Jordansmühl, Schussenried and Michelsberg Cultures and subsequently the early TRB. There are several stratified TRB axes on the hill top site at Baba (District of Prague 6, Havel 1986). Some of the field-walking finds from Kamenný stůl near Vlnoř (Prague 9, Turek, Daněček & Kostka 1998) also suggest the possible use of the Vrané material from the earliest Eneolithic. The exploitation of the Vrané outcrop became fully established in the Řivnáč period. Tough and easily workable rock became the most popular raw material for Řivnáč axes (Fig. 8). The beautiful green-grey colour of the rock with a pattern of darker veins makes a strong aesthetic impression, and this may have been crucial for the symbolic value of the axe blades themselves. Colour may in fact have been more important than functional properties, making them particularly appropriate for ceremonial exchanges of various kinds. In this context, it is important to observe that the majority of Řivnáč axes are concentrated on hill-top sites, usually those with evidence of some kind of fortification.

The significance of prehistoric fortifications in Bohemia has recently been re-examined by Evžen Neustupný (1995:199–201, 205–207). He rejected the traditional interpretation of these fortifications as having served a primarily defensive function, noting an abundance of



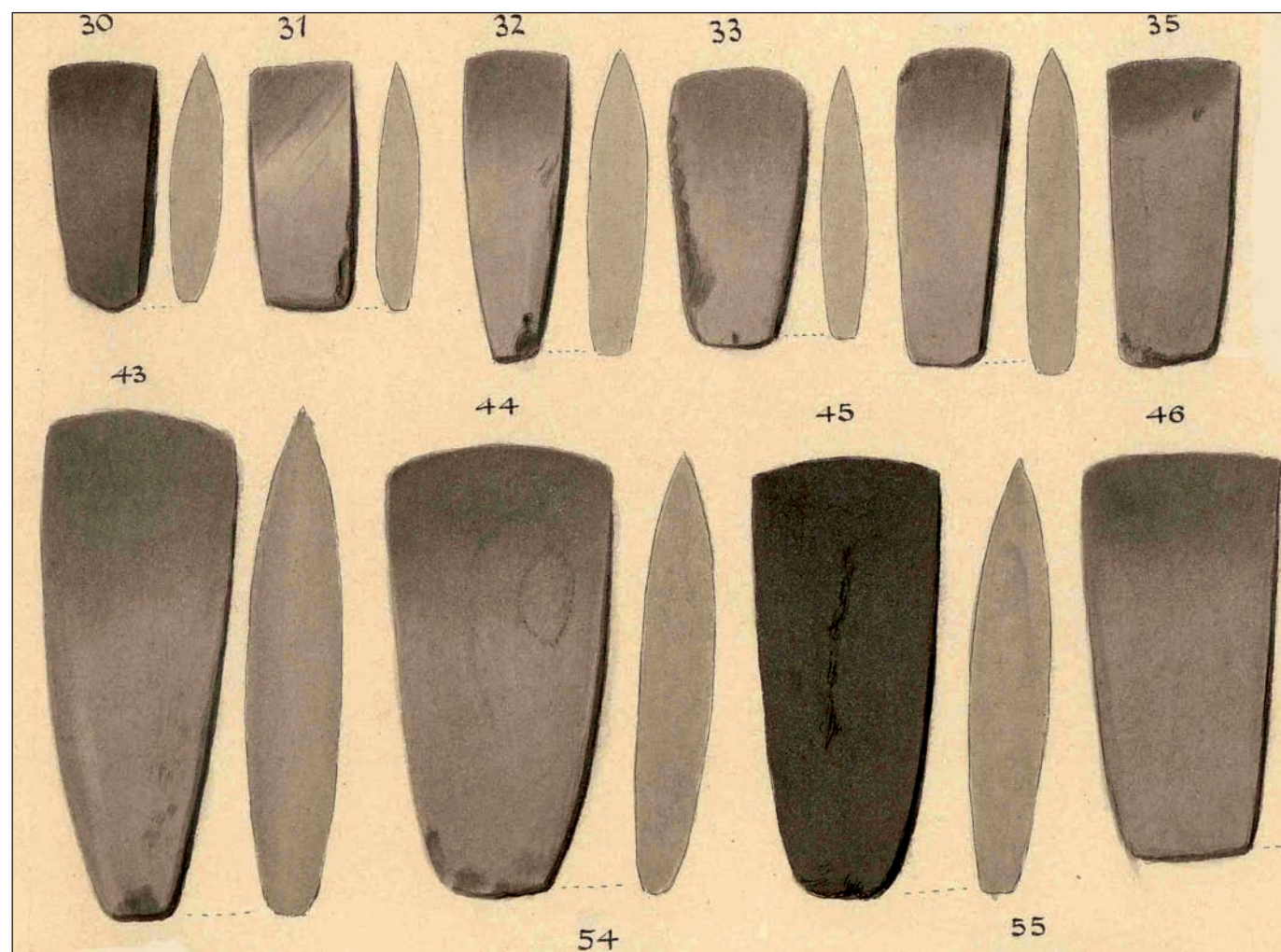
entrances and other aspects which would have limited their use in this way, particularly on Řivnáč and Cham period sites. Following Neustupný, I would argue these were generally structures of a symbolic character, with some importance in rituals and cult. Though dwellings have been identified at some (e.g. Ehrich & Pleslová 1968; Zápotocký & Zápotocká 1990), most Řivnáč/Cham hill-top sites are usually of limited area and are often located in a distinctive geomorphological position which would have mitigated against their suitability as permanent settlements. Instead, many probably saw use as places of collective and ceremonial activity, important for the Řivnáč and Cham period populations who lived, for the most part, in more lowland settings. What is interesting here is that activities such as the production and exchange of stone axes seem to have been concentrated on these hill-top sites (Turek 1997; Turek & Daněček 1997; see Edmonds 1999 for parallels on enclosures in Britain).

On some of the Řivnáč hill-top sites, axes made of green crystalline tuff represent

between 38% and 96% of the total amount of stone artefacts found on the site. On the Řivnáč period sites in central Bohemia, this material appears in the form of roughouts, working waste and finished axes. Contrasting results were achieved during the analysis of stone artefacts from two hill-top sites of the Cham Culture in western Bohemia, where the green crystalline tuff represents only up to 15% of all axes, all of them finished (see Fig. 7). One of the reasons why fragments of raw material do not appear in the archaeological collections from these sites may be the early date of their excavations (such as Bzí by Franc, F.X. 1890 in: Šaldová, V. (ed.) 1988). However, distinctive roughouts were found as early as the end of 19th Century on some of the Řivnáč hill-top sites survived in museum collections. This suggests important differences in the balance of production and exchange between these sites.

Further contrasts can also be made. Metric analysis of stone axes from Řivnáč Culture contexts, demonstrates that all sorts of axes of various sizes were made of the Vrané raw material. On Cham hill-top sites, such as Bzí, axes made

Fig. 7.
The original illustration
by Franc, F. X, 1890
(Šaldová 1988) showing
the collection of stone
artefacts from the Cham
hill-top site at Bzí.



of the green crystalline tuff are characteristically small (see Fig. 7) and were probably imported from central Bohemia as finished products. It seems then, that the source of this raw material was controlled by the communities of the Řivnáč Culture and that the circulation of axes served to maintain a form of communication between these two regions. Exchanges may have taken many forms and were probably important in mediating relationships within and between communities, from barter and marriage payments through to more ceremonial transactions (Pospisil 1963; Phillips 1979).

Corded Ware axes

The range of stone materials used for axe production in Bohemia became much more varied after 2900 cal BC, during the subsequent Corded Ware period. However, there is as yet no evidence at all that Corded Ware axes were ever made of the green crystalline tuff. It seems that after more than 1000 years of use, this distinctive stone lost its attraction, the appearance of Corded Ware material culture bringing an end to the exploitation of the source.

Corded Ware activity in Central Europe is most easily traced in funerary contexts. Settlements dating to the period are generally rare, though there are now some where distinctive ceramics reflect occupation in the early CW period (Turek 1995). These ceramics correspond in shape and decoration to the domestic pottery known from Southern Germany (Bantelmann 1989), Eastern Switzerland (Hardmeyer 1987), and some other regions of Europe (Krautwurst 1999, with a list of CW settlement finds in Europe). Unsurprisingly, most Corded Ware axes and battle-axes also come from funerary sites. Traditionally, all isolated finds of Corded Ware battle-axes were believed to be indicative of disturbed burial contexts. However, given the example of Yverdon in Switzerland, where over 250 examples were found representing all stages of manufacturing (Claus Wolf pers. comm.), it is certainly possible that some Bohemian finds are derived from settlements.

In raw material terms, the Corded Ware period stands out in terms of the range of choices made by people. This became much more variable at this time, especially compared to more restricted patterns of selection during the LBK or Middle Eneolithic periods. If we compare the data on raw materials of stone axes found at the largest Corded Ware cemetery in Víkletice in North Bohemia (Kukla 1970: 235), with petrographic analysis of raw materi-

als used in Moravia and adjacent part of Silesia (Přichystal & Šebela 1992:33–38), for the production of battle-axes, we can see a similar trend towards an extremely wide range of very different raw materials. Amongst the most common rocks are: serpentinites, schists and amphibolites, olivine basalts, nepheline basanites, diorites, porphyries, dolerites, andesites and dacites, gabbros, greywackes etc. Volcanic tuffs are rarely represented at this time, especially when compared with the Middle Eneolithic.

In technological terms, these patterns of selection of predominantly hard and resistant rocks makes sense for stone axes, which were primarily engaged in woodworking and other tasks. However, the situation is different for battle-axes and mace heads, where soft rocks such as sandstones, limestones, siltstones and mudstones were also used. In Moravia, nearly 10% of all battle-axes (n=416 pieces) were made of such soft rocks (Přichystal & Šebela 1992:34, Fig. 2). Such choices may again have their basis in function – with some weapons at least, the hardness of the stone may not have influenced utility. However, it may also be that with some weapons, what a piece looked like, as an instrument in display, mattered more than its effectiveness. This echoes the argument that warfare and fighting in Corded Ware society was often a highly structured performance, one

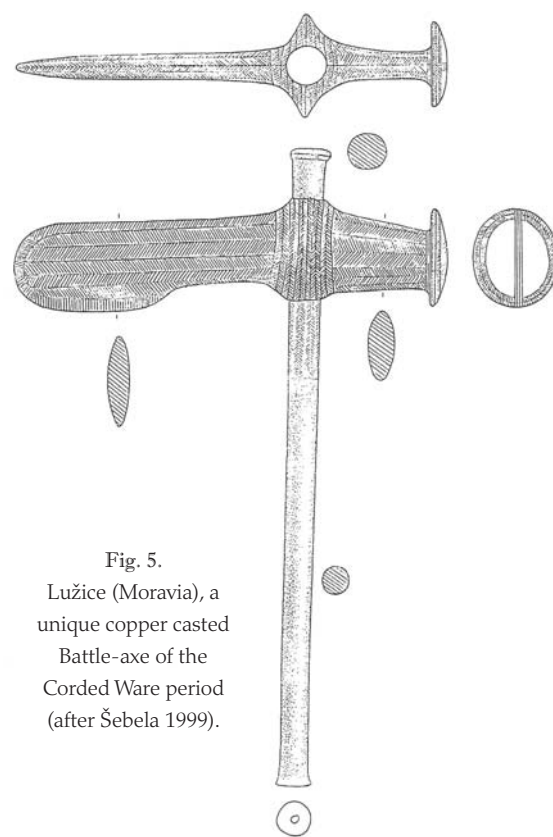


Fig. 5.
Lužice (Moravia), a
unique copper-cast
Battle-axe of the
Corded Ware period
(after Šebela 1999).



which drew upon weapons as symbols of the roles that certain members of each community were honour-bound to fulfil. For example, Neustupný suggests that: “....Ceremonial fighting by means of ceremonial weapons was an occasion for individuals to display their bravery. They risked being killed, but their fight was rather a ceremony than defence of one’s life.The warring parties apparently accepted certain ceremonial rules for which symbolic weapons were appropriate” (Neustupný 1998: 28–29). This might have included weapons made of soft rocks or even softer alternative materials.

Variability in patterns of stone selection may also have its source in other factors. Sometimes, perhaps, the distinctiveness of materials remained important, even if it could be expressed in different ways. Among the battle-axes, for example we see the use of single coloured rocks, such as green schists or amphibolites, or highly speckled rocks, such as gabbro and it may be that each mattered because it contributed to the distinctive (though not uniform) appearance of the finished artefact. In other cases, the variability may simply reflect a change away from traditions of procurement and production which were predicated on the use of established and symbolically important singular sources. In other words, what an object looked like still mattered, but not, perhaps, where it originated. In this respect, variability might reflect the use of materials that were more immediately ready to hand, that did not require a journey or some form of transaction in order to be obtained. It is even possible that this widening of choices, effectively the collection of material from a varied range of superficial deposits, had a more profound significance. The Corded Ware period in Bohemia is characterised by a sharp division in which burial is one of the only practices which required people to cut significantly into the earth. Indeed, one of the reasons why settlements of the period are so difficult to locate is that they were characterised by few, if any substantial sub-surface features. Against that background, the favouring of stone from a wide range of superficial deposits might reflect the existence of protocols which discouraged going beneath the surface save in the context of funerals. This is a very tentative suggestion, and one which will need further exploration, not least because Corded Ware serpentinite mining has been claimed in Silesia (Přichystal & Šebela 1992:35). However, we should bear in mind the possibility that patterns of choice in raw materials were most likely guided by factors far beyond issues of function.

Stone axes in Corded Ware funerary practice

Corded Ware (CW) cemeteries in Central Europe are represented mainly by single inhumation burials in a contracted position. CW female burials were usually placed on their left side, orientated with their head to the east. For male burials, the typical orientation was to the west, with the body placed on the right side. As a result of this practice, all burials of both sexes faced to the south (see Fig. 9). Male and female burials appear to be accompanied by different “gendered” artefacts. Female burials are assembled with necklaces made of perforated animal teeth as well as bone imitations of animal teeth. Necklaces were also made from small perforated shell discs. Some “solar disc” symbols of fresh water shell are also found in female graves. Among the pottery assemblage, ovoid pots are commonly found with female burials. Male burial assemblages have close associations with weapons such as stone battle-axes, mace heads or axes. The CW funerary pottery attributed to males is represented by beakers with the distinctive cord impression. It should be stressed that “gendered” artefacts should not be simply read only as a reflection of social category of the deceased person, but in some cases as a symbolic demonstration of the relations between the buried individual and other members of the community. Some artefacts may therefore rather represent the mourners and their relationship with the dead.

Corded Ware funerary practices seem to be more likely a symbolic reflection of the division of labour within the family and a reflection of the different social status of men, women and children. The individuality expressed within the context of a single burial is indicative of an individual’s association with a particular social category rather than a celebration of someone’s special skills or status achieved during their lifetime. The symbolic expression of the male and female phenomenon in burial rites probably reflects different social roles for each sex within society. The presence or absence of stone weapons seems to play an important role in this male-female symbolic distinction, a distinction that even applied to many child burials (Siemen 1992; Turek 2000). The sexual dimorphism of sub-adult skeletal remains is not developed enough to enable us to determine their sex. However, the position of the body in the grave, head orientation and “gendered” grave goods seem to respect the same system of sexual distinction.

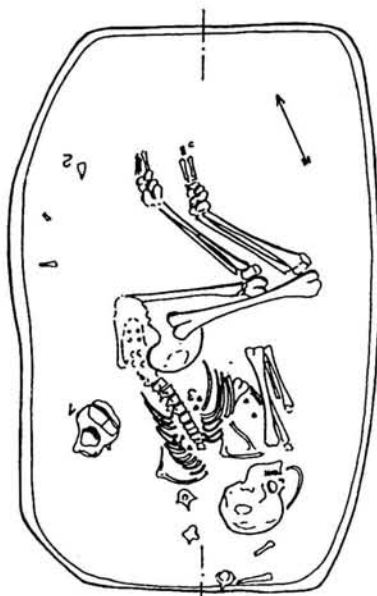
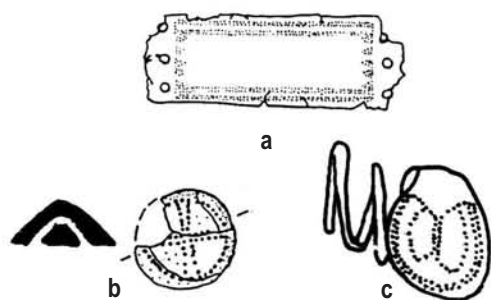
Fig. 9

A scheme of the Late Eneolithic burial customs in Bohemia. Gendered body positions and burial assemblages:

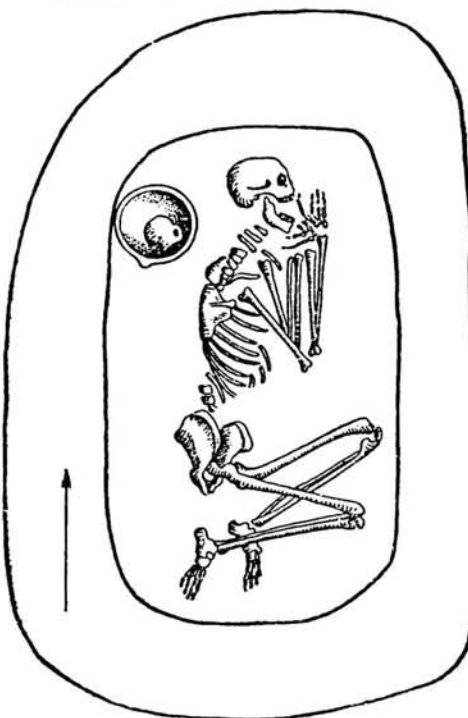
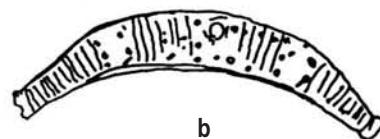
- 1: Bell Beaker female burial;
- 2: Bell Beaker male burial;
- 3: Corded Ware female and child burial;
- 4: Corded Ware male burial.

Depicted finds come from various sites and they have different scales (after Turek 2001).

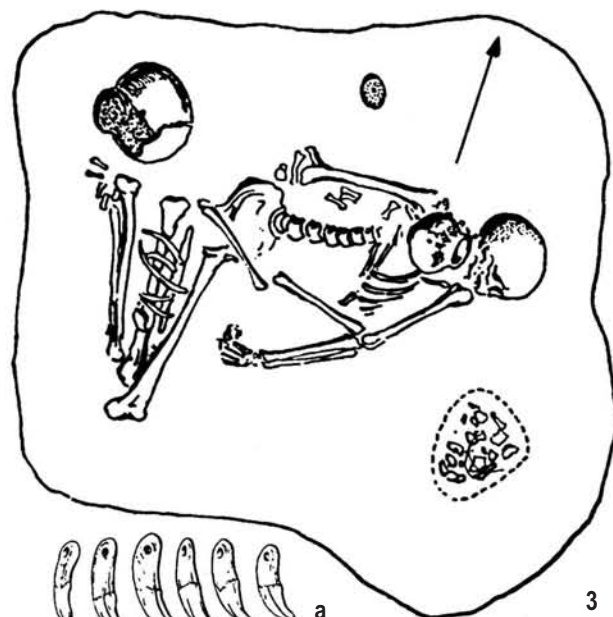
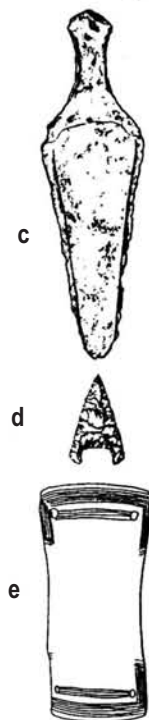




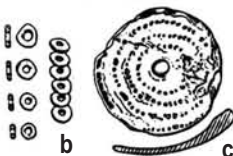
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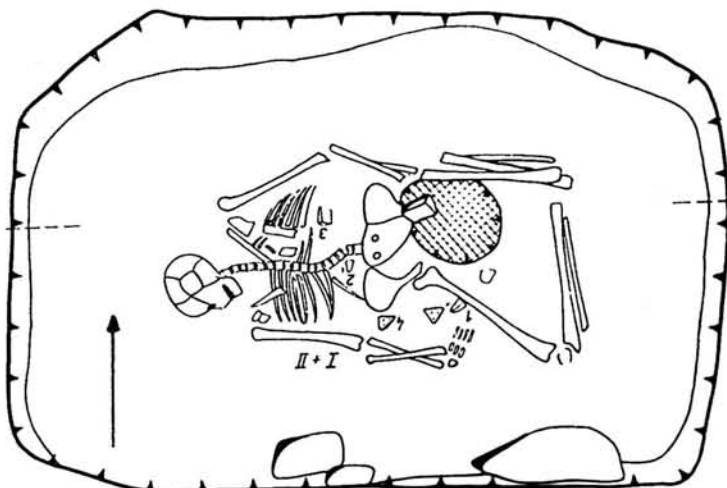
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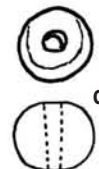
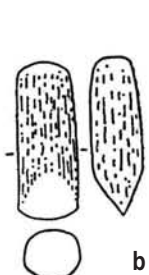
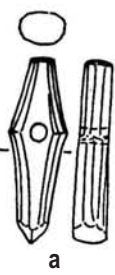
3



e



4



d



Excavations have revealed that stone tools or weapons accompany some of the child burials, mainly those buried in the male position. In such contexts, these artefacts clearly had a largely symbolic significance, perhaps anticipating the social roles that those children would have fulfilled as adults. In some particular cases, there is evidence for the burial of very young boys (six months to six years old), accompanied by hammer-axes or mace heads. Similar observations were made for the Corded Ware period in Central Germany (Siemen 1989). In Moravia, there is, for example, the burial of a five year old child with a hammer-axe from Dětkovice (District Prostějov, Čížmářová & Šmíd 1976). In Bohemia, we find the burial of a six year old child in grave 130/63 from Víkletice (District Chomutov), which included a mace head. Grave 47/64 in the same cemetery contained a burial of a child in the age category infans II, accompanied by a battle-axe (Buchvaldek & Koutecký 1970). Child burials accompanied by objects that may be interpreted as symbols of wealth and social status do not reflect the pre-historic reality of the social relations, simply because these children died so young. Because other male child burials do not include any of such symbolic artefacts, it can be assumed that this group of sub-adult male burials may represent socially favoured individuals of some sort. They might have been firstborn sons, potential heirs of social status and wealth within a family or a wider community. Similar observations were made by Susan Shennan (1975) at the cemetery of the Nitra Culture at Branč (south-west Slovakia). Here a small group of sub-adult women were buried with rich copper necklaces and other jewellery. On the other hand the majority of girl's burials on this site were assembled with ordinary artefacts. Shennan assumes that this evidence may suggest the existence of a "system of ascribed hereditary wealth". It is possible that this is evidence of the initial stages in the development of social differentiation, which carried on within Bronze Age communities. Such social differentiation might have been as a result of progressive changes in the system of agriculture and food production, namely the introduction of ploughing implements, teams and the Secondary Products Revolution (Neustupný 1967; Sherratt 1981).

Dividing polished stone artefacts into two categories: weapons and tools, I tried to follow their position in graves of the Corded Ware Culture, especially in relation to the gendered position of buried body. As I mentioned earlier, stone weapons, such as battle-axes and mace

heads do not appear in the graves containing burials in the "female" position. Weapons with male burials were usually placed in front of the upper part of body, near its chest or face; the same goes for mace heads and massive axes. These artefacts were perhaps perceived as the main attributes of masculinity and perhaps the focus of symbolic arrangements within the grave. The smaller flat axes were, however, more often found behind the head or back of the buried individual. Considering the position of weapons and massive axes in front of the chests, and near the arms of the dead, it may be that these items were regarded as particularly significant – for what they said about the deceased and their relation to the community of mourners, and/or for those activities that they would undertake in the afterlife.

Stone in the age of bronze

Battle-axes went "out of fashion" with the appearance of Bell Beakers. The role they had played in Corded Ware and earlier periods was replaced by new items and new practices through which ideas about identity – gender, age and social standing, could be given expression. These included copper daggers and the paraphernalia associated with archery.

That said, battle-axes were not forgotten altogether in the Early Bronze Age. Several stone 'saddle groove' battle-axes have been recorded in Bohemia and Moravia (Figs. 10 & 11). Usually identified as isolated finds, their connection to the Únětice Culture has nonetheless been established by finds from a burial at Polepy (grave XXIII, Dvořák 1926–27) and from a settlement pit excavated in Prague-Ďáblice (Neustupný, J. 1936–38:122–123). The surface of these artefacts is usually purposely coarsened and only those parts that were originally covered with the hafting bonds remained polished. The butt of the battle-axes is usually rounded or slightly pointed, again perhaps resembling a phallus in its shape. The vast majority of saddle groove battle-axes were made of a Proterozoic porphyrite, an igneous rock which has its natural occurrence in the Křivoklát-Rokycany area.

These battle-axes appear at a time when bronze axes and other bronze woodworking tools had become common. The question, of course, is why they were made and used? Some suggest that they were pounders for crushing copper ore (Neustupný, J. 1936–38; Pleiner & Rybová 1978:340 Fig. 90:20, 364). However, this explanation does not seem to be supported by



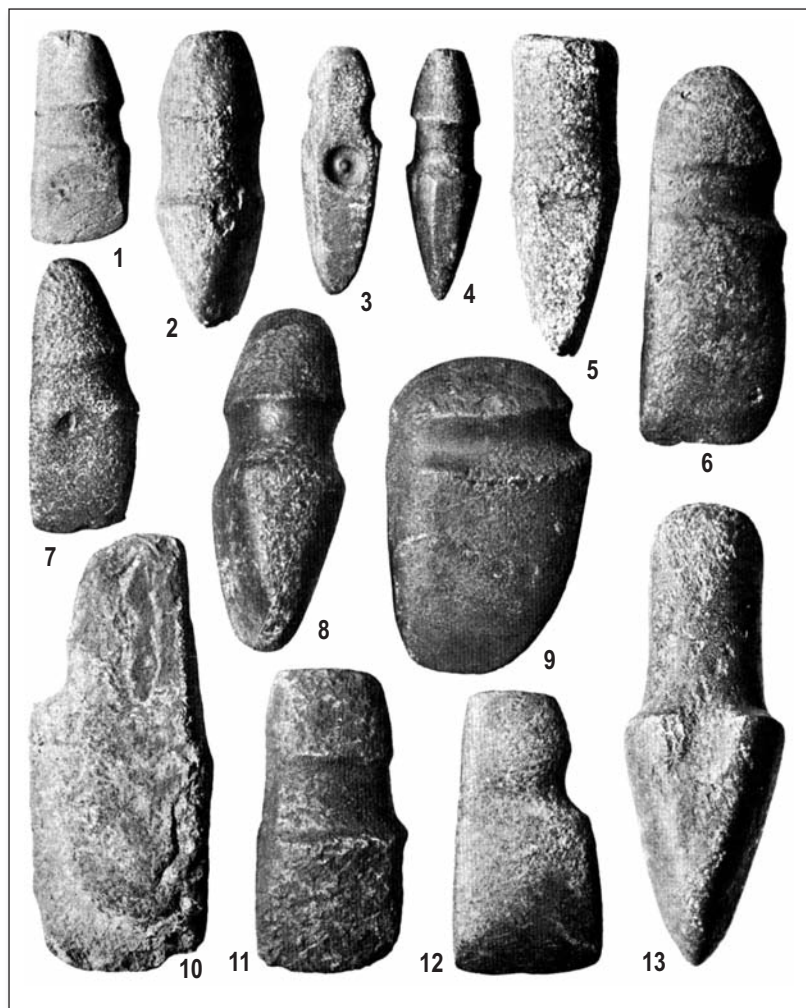


Fig. 10

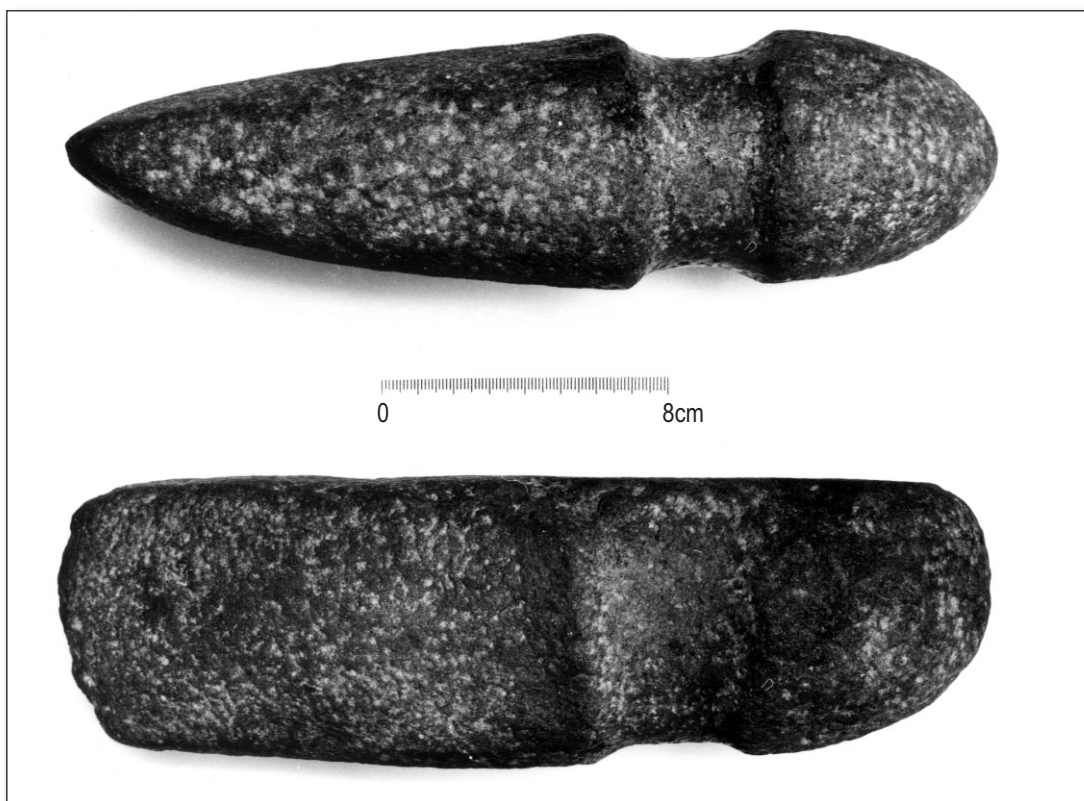
A collection of Bohemia:

- 1: Praha Hloubětín;
- 2: Klášterní Skalice;
- 3: Lisovice;
- 4: Slaný – Slánská Hora;
- 5: Tursko;
- 6: Řepín;
- 7: Litovice;
- 8: Praha-Čertovka;
- 9: Stradonice;
- 10: Praha-Šárka;
- 11: Kamýk;
- 12: Klobuky;
- 13: Sokoleč.

(after Stocký 1928, tab. XIX).

Fig. 11

The Early Bronze Age saddle grooved battle-axes from Prague, unknown site (photograph by J. Brožek).



the varying dimensions of these artefacts (lengths vary from 7–30 cm) and any traces of wear that could possibly suggest their use for this kind of work have not been recorded. Also, the crushing and processing of ore usually took place at or near the place of extraction. Yet these battle-axes are distributed all over the Únětice settled area and they do not concentrate around known outcrops of copper ore. This suggests that they had other uses.

In the classical phase of the Únětice Culture bronze became the common material for production of tools. After almost two thousand years of knowledge of copper metallurgy in Central Europe, stone was fully substituted by metal. This change seems to have been rapid and happened during some transition period, which was probably the Proto- and early Únětice Culture. Unfortunately, tools and weapons appear only rarely in the burial context of the Early Únětice Culture (Matoušek 1982) and as the evidence of settlement finds is scarce, it is very difficult to document this process of transition. Within the Proto/Early Únětice cemeteries in Bohemia, only 3 axes were recorded, two of flint imported from Northern Europe and one of polished stone. Bronze axes became far more common in the classical period of the Únětice Culture, however the majority are known from hoards; axes of both materials are generally rare in graves.



Against this background, the lack of context for most stone battle-axes is frustrating and leaves many possibilities open. One of these however, which may be worth considering is that these distinctive stone artefacts were important because they stood for the past and for aspects of an older order. In other words, their form and material looked back to a time when several aspects of identity and authority had been mediated by the working, use and display of stone. Such patterns have been noted elsewhere, as in the case of flint knives used in Egypt throughout the New Kingdom up to the Roman period for ritual butchering (Ikram 1995:69–70). This interpretation should be considered in the context of other characteristics of these battle-axes, such as the deliberate choice of the same raw material for most of them, great variability in their sizes, their pecked-roughened surface which seems to be in opposition to smooth metal and last but not least their distinctive phallic shape. This may suggest a certain continuity of the symbolism of male patriarchal principles, as is presumed for the preceding Late Eneolithic period (Neustupný 1967). These final battle-axes were effectively made as relics.

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Changing contexts, changing meanings:

Flint axes in Middle and Late Neolithic communities in the northern Netherlands

Abstract

Throughout prehistory, axes played an important role in both ritual and domestic life. In fact, the axe is perhaps the implement par excellence to illustrate the interconnectedness of the two domains. However, by tracing the biographies of flint axes, it is possible to identify a variety in the ways that different blades were caught up in the flow of social life.

This paper draws together evidence from the northern Netherlands to track changes in the character, use and deposition of axes from the Funnelbeaker (TRB) Culture through to the appearance of Bell Beakers and the first metalwork.

Patterning in this evidence demonstrates that axe blades were pivotal in the representation of systems of meaning for well over a thousand years. They were prominent in traditions of selective deposition, traditions that differentiated blades on the basis of their biographies; their form, size, use and origins. Details on the character and chronology of these deposits suggest that these traditions underwent subtle changes with the passage of time.

Introduction

Throughout much of later prehistory, flint axes were highly practical tools, used for such things as house construction and the clearance of forests. In the Northern Netherlands, their presence in hoards and graves indicates that they were also prominent in the ideological life of prehistoric people, implicated in systems of selective deposition (Fontijn 2002). However, this system was not constant. In each phase of the sequence, people used and treated flint axes in a different manner. These differences suggest that the cultural biography (Kopytoff 1986) of flint underwent significant transformations through time, starting with the Funnelbeaker culture up until the introduction of the first bronze axes (c.3400–2000 cal. BC).

Different research methods have been used to reconstruct the biographies of these axes. This included a typological and technological analysis focused on the physical appearance of the axe and its origins. Spatial analysis using GIS software was used to study the locations in the landscape where these objects were deposited, both in relation to other archaeological sites as well as the natural landscape. Finally a large sample of flint axes was subjected to a use-wear and residue analysis using high-power microscopy (for methodology see Van Gijn 1990).

The Funnelbeaker culture: axes, bogs and megaliths

Although domesticates were available in the previous Swifterbant culture, hunting, fishing and gathering remained important in subsistence. It was not until the start of the Funnelbeaker TRB, around 3400 cal. BC, that the switch was made to a more fully agrarian lifestyle. It is at this point, with the onset of the TRB, that the flint axe becomes a prominent feature in the material repertoire, associated with both domestic and ritual domains.

The core area of TRB habitation and for the construction of megalithic tombs within the present-day Netherlands, was the Drenthe Plateau, a till plateau more or less surrounded by extensive raised bogs and marshes and intersected by many small streams. The axe naturally became an important tool for these first farmers to clear the dense forest still present at this time. Their appearance in both graves and depositions in waterlogged places shows that the flint axe played an extremely important role in TRB cosmology. Although flint axes occur in



Fig. 1.
Map of the Netherlands,
the grey square indicating
the province of Drenthe.

both these contexts it will be argued here that they represent very different categories in TRB cosmology, categories that were strictly separated and could not be mixed.

TRB axe deposits

It has long been known that the TRB people of the northern Netherlands deposited large imported axes in waterlogged places (Achterop 1960; Ter Wal 1996). It was, however, not until these axes were systematically studied from a biographical perspective that we learned more about the role these objects played in TRB cosmology (also see Wentink 2008, 2006; and Wentink & Van Gijn 2008). It is also established that the axes deposited in the bogs were typically very large (often exceeding 25cm in length) and their functional properties have been questioned by various researchers (Bradley 1990; Bradley & Edmonds 1993; Tilley 1996). This is because their great length makes them extremely susceptible to end-shock, a type of fracture which causes the axe blade to snap upon impact. Moreover, many of these large axes from wet contexts were never ground or polished. Although these were imported from southern Scandinavia or northern Germany, they were often deposited in a seemingly unfinished state.

The assumption that these axes were too large to have been used for practical purposes is corroborated by the functional analysis, which indicates that no axe larger than 22 cm showed any trace of either use or hafting. It is therefore proposed that the extremely large axes that are typically found in intentional deposits were not meant for functional activities and, more importantly, could probably not have been used in the first place. This means that TRB craftpersons in southern Scandinavia



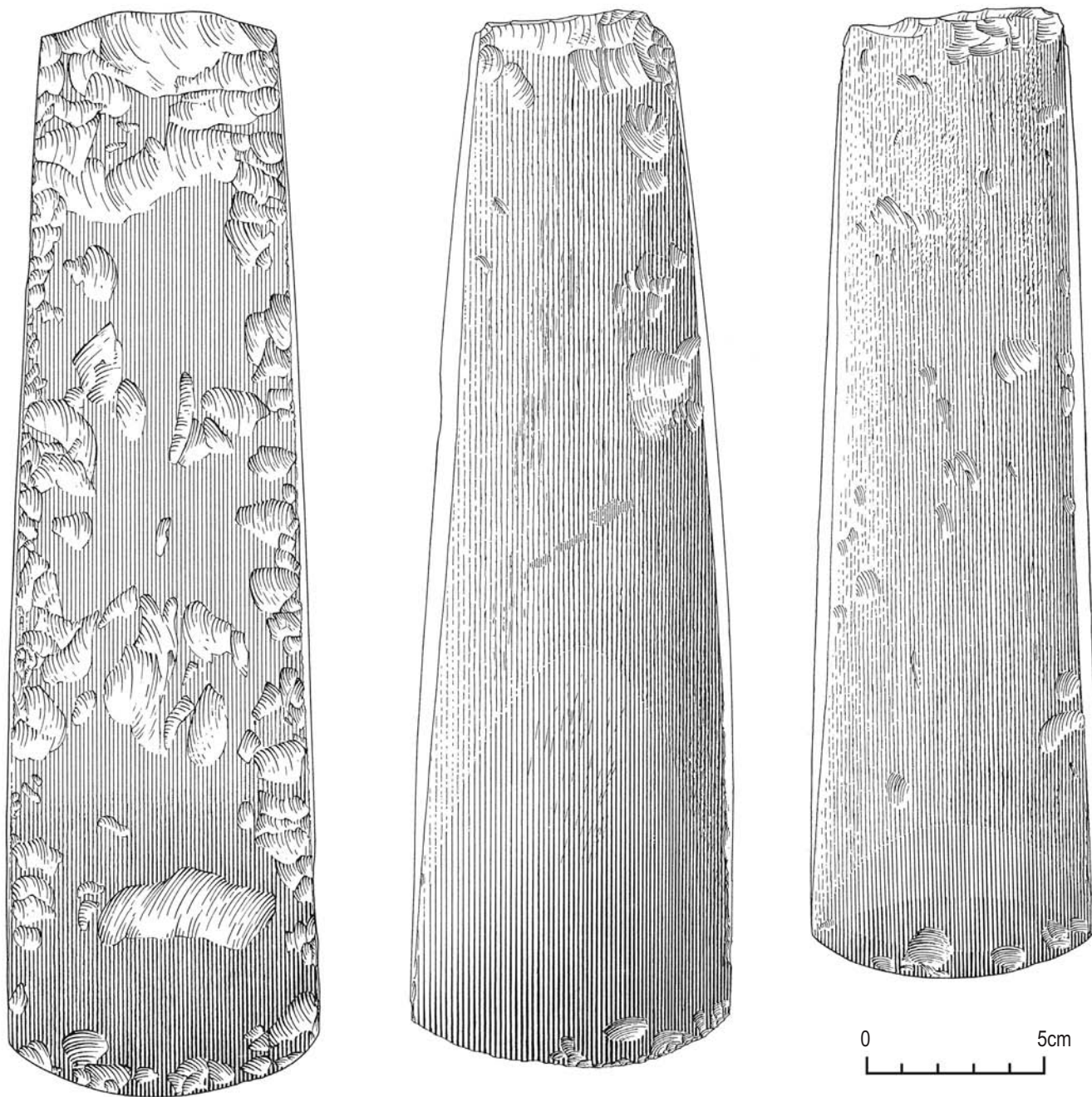


Fig. 2.

TRB deposition of three highly similar axes near the town of Valthe (hoard of Valthe III), private ownership (drawing H.R. Roelink B.A.I.).

were actively producing non-functional axes that were exchanged over great distances (up to 400km). These axes appear to have ended their lives of exchange in waterlogged places, either as single objects or as part of multiple-object hoards containing axes, axe blanks, nodules of flint and the occasional flint chisel. These acts of deposition took place in specific locations in the landscape. Although the Drenthe plateau was surrounded by extensive raised bogs, deposition did not take place there. Instead, all hoards with a known finds context were retrieved from the edge of bogs along the small streams intersecting the Drenthe plateau. Axes were thus deposited in specific locations

associated with running water at the transition from sand to marsh.

Although none of the blades from hoards displayed any traces of functional use, they did display other, very characteristic, traces and residues. Most of the axes, especially the unpolished specimens, showed wear traces on all protruding parts (ridges and ribs). It has been proposed that this type of wear was caused by a material that had surrounded the axe. Experiments indicated that the most likely activity to have caused these traces was the repeated wrapping and unwrapping of the axes in a particular material (Wentink 2006:62). It is not yet clear which material was used to wrap



the axes, but the process of wrapping and unwrapping must have been repeated innumerable times to have caused the degree of wear observed.

Wrapping of important objects is not an uncommon phenomenon. Ethnographically it is well and widely documented that objects with special powers are kept hidden, often being wrapped, only to be revealed and unwrapped on special occasions and/or in the presence of initiated persons (Akerman *et al* 2002; various sources cited in Wentink 2006: 89). Given the physical nature and the find-context of the large TRB axes, such a scenario, in which the axes were seen as objects with special powers that needed to be shielded, seems very plausible.

Apart from the traces of wrapping, the functional analysis also indicated that most of the axes from hoards showed traces of red ochre, often located on or near the cutting edge. The flint nodules from the hoards also contained ochre residue, which is either the result of having been entirely painted red or perhaps they were decorated with special motifs. That we are indeed dealing with red ochre was confirmed by X-ray powder diffraction analysis performed in cooperation with the Delft University of

Technology (Dik 2006). Unfortunately, it is impossible to tell during which stage in the life of these objects the ochre was applied.

All evidence indicates that these large axe blades had a very special use life. Being far too large to have been employed in practical activities, they were produced as special objects. Already during production, these objects were imbued with a special significance which placed them apart from every day tools. After production they were exchanged over hundreds of kilometres, before being deposited in specific waterlogged places. During their lives of exchange they were never used but, instead, were wrapped and unwrapped repeatedly, presumably as a function of their circulation and probably for display purposes. Analysis also reveals that ochre was applied to these blades, especially near the cutting edge.

All ceremonial TRB axes from waterlogged places appear to adhere to the above described patterns. We are thus dealing with a highly structured ritual that was performed widely, at least covering the entire northern Netherlands, but possibly a much larger area. These axes must therefore have played an important role in TRB cosmology. Following Godelier (1999) and Weiner (1985, 1992), it is likely that such

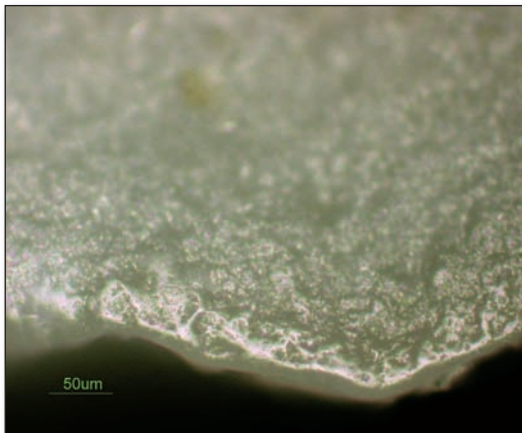
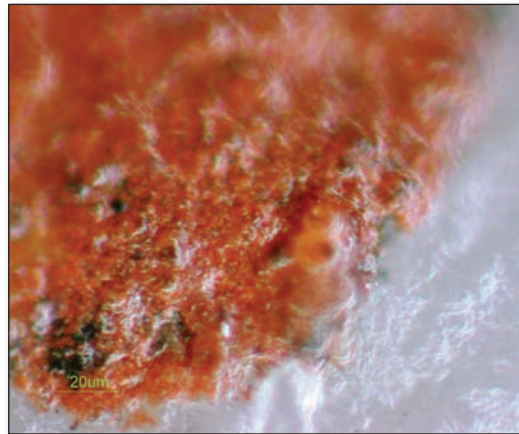


Fig. 3.

Residue and wear traces on TRB axes from hoards.

1:

Ochre on cutting-edge of axe of the
hoard of Een 1898 (stereomicroscope 10x)
(National Museum of Antiquities).

2:

Ochre on cutting-edge of an axe from the same hoard
using polarized light (metallurgical microscope 500x).

3:

Wear traces of wrapping on the sides of the axe
of Zuidbarge (metallurgical microscope 200x)
(Drents Museum Assen).



practices could only be perceived as legitimate by the majority of society if the 'authentication' of these axes lay outside the domain of the present, in the sphere of ancestors, spirits or gods. Craftpersons producing special items often claim that their knowledge and skills are a gift from the ancestors or spirits that first introduced these objects (Helms 1988). The technology to produce an axe in this scenario would have been seen as a gift from those entities who subsequently reside in it.

TRB axes from graves

The TRB axes found in depositions differ greatly from those retrieved from graves. Instead of large imported and unused objects, graves usually contain small, locally produced and heavily used axes. The axes from the megalithic graves are often not larger than 12–14cm and although some appear to be worn-down imported axes, most are likely to have been made locally. They show clear traces of hafting in the form of friction gloss on the butt half and the cutting edges are often worn and rounded, showing use polish indicative of chopping wood. Many were resharpened before they were deposited in the graves as if to prepare them for future use.

However, the traces of use remained in the deeper scars of use damage. In fact, often multiple facets of grinding and polishing can be seen resulting from a long and intensive use life which included many resharpening phases.

The axes found in graves thus represent heavily used tools which played a vital role in these early agrarian communities. These axes were used to lay out fields, to build houses and fences and for various other wood-working activities. They therefore represent important tools used to transform the natural forests, which in the early TRB phase still predominated in the northern Netherlands (Spek 2004:209; J.A. Bakker 1982:114; R. Bakker 2003), into a cultural landscape consisting of fields and settlements. Whether these tools should be seen as personal possessions belonging to the individual dead, or the community as a whole cannot be ascertained but, certainly, it was their role in important communal activities that made them suitable as grave gifts.

The TRB: conclusion

The use lives of the axes from graves are markedly different from those deposited in waterlogged places. Both appear to have been

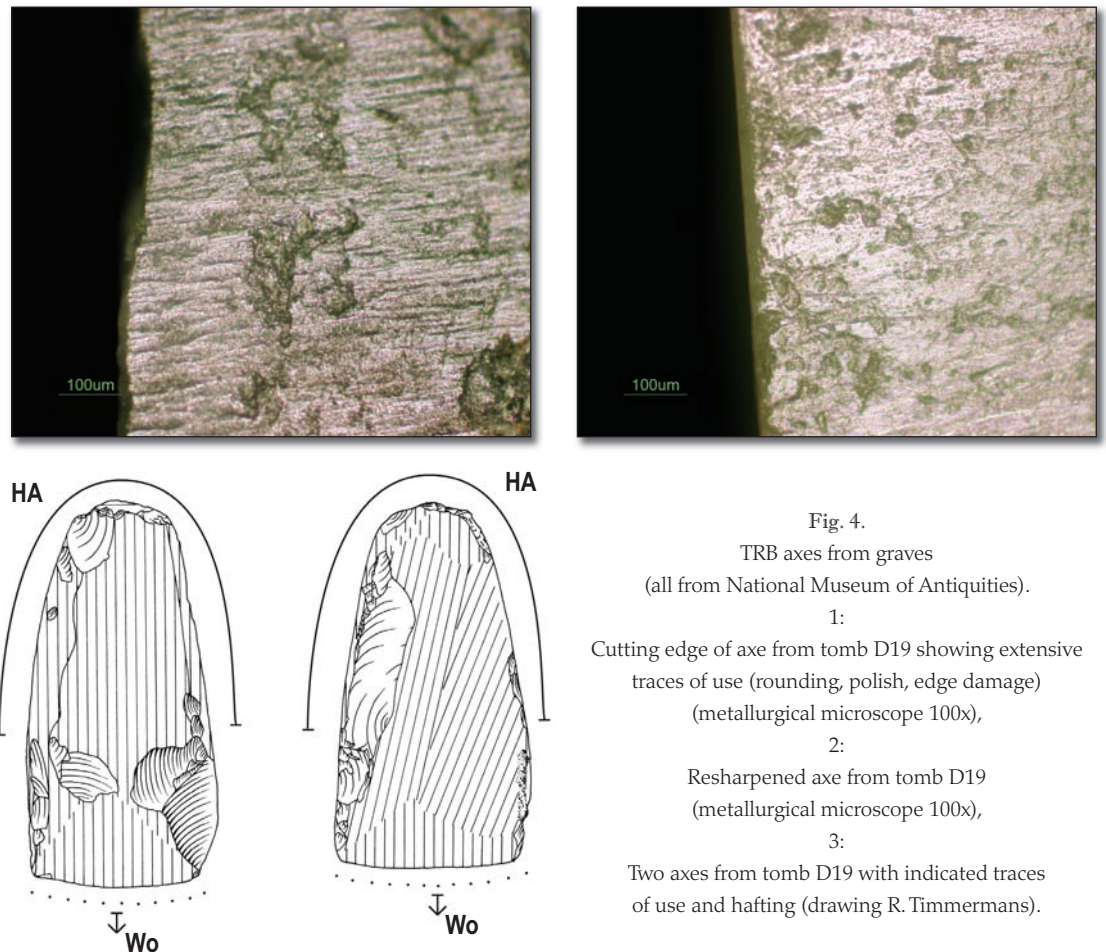


Fig. 4.

TRB axes from graves
(all from National Museum of Antiquities).

1:

Cutting edge of axe from tomb D19 showing extensive traces of use (rounding, polish, edge damage) (metallurgical microscope 100x),

2:

Resharpened axe from tomb D19 (metallurgical microscope 100x),

3:

Two axes from tomb D19 with indicated traces of use and hafting (drawing R. Timmermans).



very important and both were subjected to selective deposition, but they played very different roles in TRB society. The tombs represent places that were visited time and again. They contained the remains of members of the local group and formed the focus for rituals performed by those very people. As such, they were places deeply embedded in the history and genealogy of the local group. The grave gifts deposited in these places were often objects associated with communal activities performed by that community such as usable axes, cereal harvesting tools and arrowheads likely to have been used for hunting (Van Gijn 2010).

The large ceremonial axes, imported from distant places, represented very different values. They were likely to represent the mythical ancestral beings recognised and respected by the larger Northwest Group of the TRB. They transcended the local and as such could not be permanently appropriated by a local group through the act of deposition in a tomb. At some point in their use lives they were extracted from circulation and placed in waterlogged places. They were deposited at the edge of the higher habitable ground at the transition to the bogs, usually near running water. By doing so they were placed outside the everyday domain of a local group and perhaps in a domain that was conceptually shared between all TRB groups.

The Single Grave culture: axes, bogs and barrows

In the northern Netherlands the TRB was succeeded by the Corded Ware or Single Grave culture (SGC) around 2900 cal. BC. The SGC is usually typified by the introduction of the first barrows covering a single inhumation. Characteristic protruding foot beakers, decorated with cord-impressions, the first disc-wheels and the widespread use of the ard are also associated with the SGC (Van der Waals 1964). Within the Netherlands, the distribution of the SGC is mostly limited to the northern half of the country.

The SGC axes are, in contrast to the TRB ones, less standardized and seem to have been made by less expert flintknappers. They also display a different type of polishing, which includes the more pronounced flake negatives. Experiments have shown that these were probably polished by means of a piece of hide or leather combined with water and fine sand (Van Gijn 2010).

SGC axe deposits

Based on axe typology and technology, a total of nine multiple object hoards can be dated to the SGC. Although these hoards primarily contain axes, there are a few notable differences in composition compared to those of the TRB. The TRB hoards contained axes in different stages of production, nodules of flint and the occasional flint chisel. In the SGC, no nodules of flint have been found but, instead, other tool types are introduced. These include small flint scrapers or the long (7–16 cm in length) flint blades imported from northern Germany and southern Scandinavia (Harsema 1981; Ter Wal 1996).

Fig. 5.
SGC hoard of
“De Pieperij”
(Drents museum Assen,
photography J. Pauptit).



At first sight, these SGC hoards do not seem to be all that different from TRB hoards. The places in the landscape where deposition took place appear to be the same, generally situated at the transition from the higher sands to the peat in the stream valleys intersecting the Drenthe Plateau. Many SGC axes from hoards, like their TRB counterparts, display residues of red ochre on or near the cutting edge. However,



there are also differences. Although the largest SGC axe from a hoard measures 24cm, most are not larger than 15cm. In contrast, the TRB hoards predominantly contain axes of extreme sizes (>25cm). Moreover, in contrast to the large TRB axes, the majority of the SGC axes were most likely produced on locally available flint. The most important difference, however, between the axes from TRB and SGC hoards lies in their use lives. Unlike the TRB axes from hoards, most of the SGC axes from depositions were hafted and show wear traces from chopping wood. None of them showed the characteristic traces of wrapping seen on the large TRB axes. In many respects therefore, these axes are very similar to those deposited in TRB graves. They show clear traces of an intensive utilitarian use life which includes several phases of resharpening (Van Gijn 2010).

None of the TRB axes from hoards showed traces of use and it was argued above that they were especially produced as ceremonial objects that were not meant to be used. Their special powers were said to have largely originated in the act of production, which was why they were subsequently treated as special objects. With the SGC axes this is completely different. As with the axes from the TRB tombs, the SGC axes from hoards appear to have been primarily valued and deposited because of their importance in key aspects of daily life. These were the tools used for laying out fields, the construction of houses and all sorts of woodworking tasks, possibly including the manufacture of such items as disc-wheels, carts and ards. As such, in terms of their biography they bear a closer resemblance to the axes deposited as grave gifts in the megalithic tombs during the TRB. They seem to have been associated with the local group, representing communal values.

SGC axes from graves

Flint axes were often incorporated as grave goods in SGC barrows. More often than not, deposits took the form of a single small axe; on those less frequent occasions where two flint axes were placed in one grave, there is often a substantial size difference between the blades (Drenth & Lanting 1991). Possibly, the two axes represented tools used for two distinct activities relating to either heavy woodworking or fine carpentry.

A selection of axes from SGC graves, predominantly from the province of Drenthe, has been studied for traces of use and residue (Van Gijn 2010). As is the case with the axes from SGC hoards and TRB graves, the axes from the barrows generally appear to be used. They dis-

play distinct traces of hafting, rounded and damaged edges and use polish related to chopping wood; incidentally, ochre can also be detected. Not all axes from barrows show traces of use, however. One remarkable exception is the axe from the barrow of Vaassen which measures no less than 27cm in length. As was argued above, a flint axe of this size does not appear to be very useful as the risk of breakage is considerable. Indeed, no traces of use or hafting could be detected on this axe. Interestingly, this is the largest SGC axe in the Netherlands. As was the case with the large TRB axes, this specimen must have been imported as a finished tool from either southern Scandinavia or northern Germany, based on the raw material it is made of. However, in the TRB such an axe would have been deposited in a wet context and would never have been placed in a grave. The fact that this axe was retrieved from the central grave of a SGC barrow indicates that categories had shifted by this time, as had the system of selective deposition.

In this context it is relevant to note another aspect of the SGC grave gifts. The TRB graves generally contained tools from everyday life, related to such activities as the preparation of the fields, harvesting, food processing, hunting and house construction. These tools were made of local flint. With the SGC graves, however, we see an increasing focus on exotic flint items that came from far and that seem to lack evidence for a utilitarian function (Van Gijn 2009, 2010). The above-mentioned large, unused axe from Vaassen is one example. Long flint blades, most likely northern imports, also regularly occur in SGC graves; these blades do not show traces of use. In the later SGC beautifully crafted daggers made from Grand-Pressigny or Romigny-Léhry flint were deposited in the graves, imported as finished items from France. Use-wear analysis of the Dutch finds shows polish from contact with plant and/or hide. Unlike the polish from wrapping seen on the TRB axes from the hoards, this polish displays a clear directionality that indicates a repetitive movement; however, this polish is most well-developed on the surface and ribs away from the cutting edges of the dagger, making it highly unlikely that the daggers were used in a utilitarian activity. Instead, they must have been due to the dagger being pulled in and out of a sheath innumerable times. It is therefore argued that these items were displayed on special occasions (Van Gijn 2009, 2010).

The flint objects deposited in the SGC barrows thus show a mix of local and exotic elements, elements that were strictly separated in



the preceding TRB. On the one hand there were used tools representing elements of everyday life, on the other were items that came from afar and which did not appear to have had a utilitarian function. The majority of the axe blades from the barrows were implements with a long use life in communal activities. They were made of local flint. Their presence in the grave may refer to the importance of the local community, similar to what was observed for the axes in TRB burial practices. In contrast, some of the other flint items in SGC barrows, like the long blades, the occasional large axe and the daggers, have an exotic origin and are clearly non-utilitarian. Because of their rarity and display function, some items, such as the French daggers, may have been important in the construction of specific kinds of personhood.

The SGC: conclusion

Flint axes remain significant during the course of the SGC. As in the TRB period, they are found both in multiple-object hoards and in burial contexts. However, upon closer inspection, the biographies of the axes in these two contexts differ substantially. The SGC hoards contain axes made of local flint with evidence for a long use life, often displaying ochre residues. In the TRB, such axes ended up in the megaliths and would never have been deposited in water-logged places. On the other hand, SGC graves have a mix of locally made and used axes and exotic objects that lack traces of regular use. Such exotic flint objects are consistently absent in TRB burial contexts.

We can thus observe shifts in depositional practices that otherwise have a long time depth. It is difficult to determine if and if so, how, such changes might be perceived by the agents performing these practices. Maybe small shifts in *habitus* took place within the *longue durée* rather than a sudden breakdown/transformation of the old depositional 'rules' and system of meanings. The fact that in the SGC we find exotic display items in graves suggests that this shift might be related to a change in the perception of communal identity and the expression of specific kinds of personhood. However, to come to a better understanding of SGC identity and personhood we must take other evidence into consideration. This however falls outside the scope of the current paper and forms part of a new research project entitled 'Ancestral Mounds' currently carried out at Leiden University by the authors.

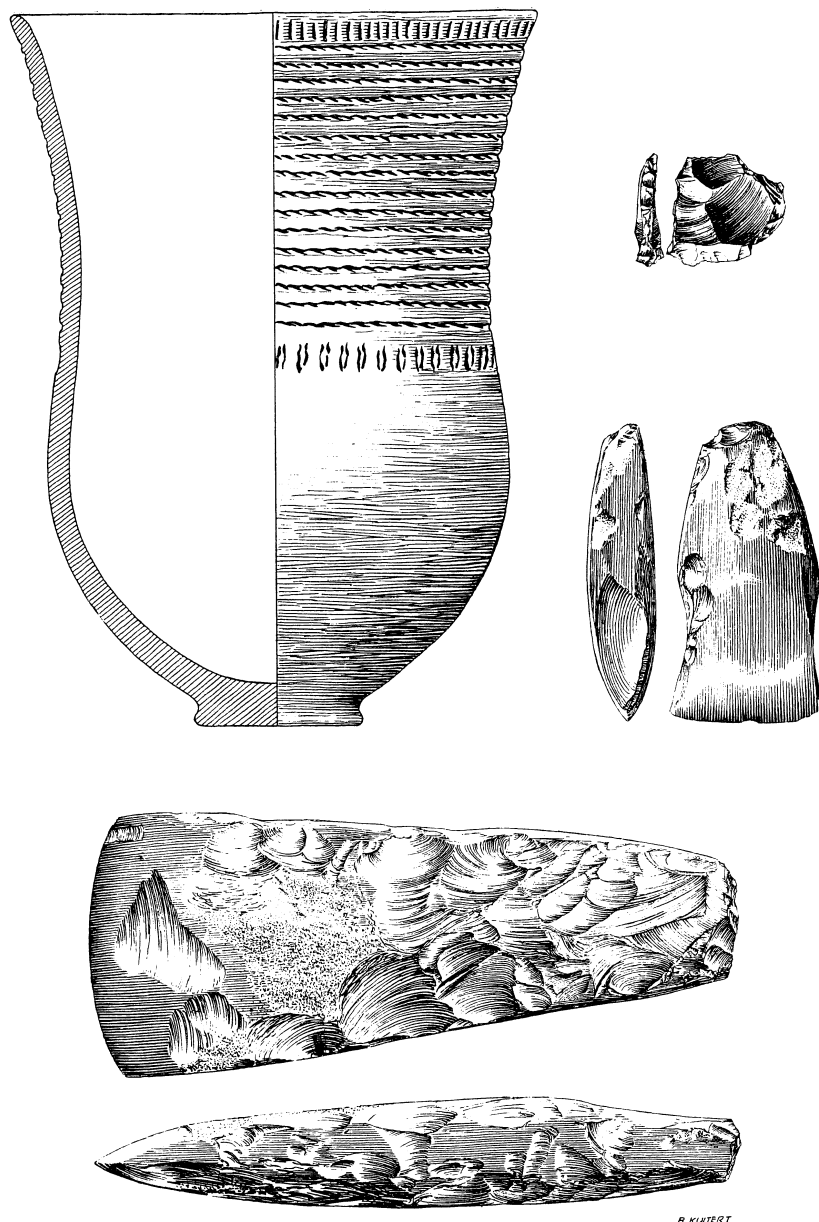


Fig. 6.
Inventory of a SGC grave
from a barrow in Eese,
Steenwijk (Drenthe)
containing two flint axes,
scale 2:3
(Waterbolk 1964).

The Bell Beaker culture: the rise of metal

The role of flint axes in burials and hoards or single deposits decreases sharply during the Bell Beaker Period (2500–2000 BC). Flint axes are not found as part of the burial equipment, the small heavily used axe from Lunteren forming one exception. Interestingly, depositions as a whole have become extremely rare in this period. Particularly for the first phase of the Bell Beaker Period (2500–2300 BC), there is hardly any find that can safely be interpreted as a deliberate deposit at all. The first known instances date from the later Bell Beaker Period (2300–2000) and concern mainly metal items of copper alloys (Fontijn 2002:chapter 5). It is not just the material that is new, there are now also object types figuring in deposits that lack precedents in stone or flint; artefacts like the halberd and the double axe. The well-known hoard of Wageningen, buried close to burial mounds, even contains a remarkable combination of copper items, a flat axe, halberd, dagger, and items that may probably be interpreted as ingots and scrap metal (Butler 1990). Flint axes no longer seem to have played any role in wet context deposition and the only non-metal item known from this period is – curiously – a stone axe in the Wageningen hoard. Rare as the examples of deposits may be during this period, there are again indications for selective deposition. There is – again – a separation between valuables associated with the construction of a particular kind of personhood in burials on the one hand, and valuables deposited in watery places on the other. Copper axes are clearly lacking in burial contexts, and this is largely true for Bell Beaker graves everywhere in the West European region. This cannot solely be related to the special significance of early metal, since copper daggers, awls and gold ornaments do play a role in Bell Beaker graves (Butler/Van der Waals 1966). During the Bell Beaker Period, copper axes thus seem to have replaced flint axes entirely in burial and wet-context depositions, but within the framework of an already existing system of selective deposition. With the rapid increase of metalwork deposition from 2000 BC onwards, this would only become more outspoken and axes – now made of bronze – would become the single most important item in depositions for the entire second millennium BC.

Differences through time; continuity and change

Throughout prehistory, axes played an important role in both ritual and domestic life. In fact, the axe is perhaps the implement *par excellence* to illustrate the interconnectedness of the two domains, being an important practical tool whilst frequently occurring in ‘ritual’ contexts such as graves and/or other formal deposits. The axe appears to have been a significant category, an object of thought, for the entire sequence. However, by tracing the biographies of flint axe blades through time, we have shown that their roles in selective deposition, indeed, the meanings that axes held for prehistoric people, seem to have changed considerably.

In the TRB, two groups of axes existed that must have represented distinct categories in TRB cosmology and which could not be mixed. On the one hand, there were the large unused imported axes which were deposited in waterlogged places. These were produced as special items and throughout their use life were circulated and treated as such. On the other hand, there were the small, intensively used and often locally produced axes that accompanied the dead in megalithic tombs. So, we have two types of axes, each with a completely different biography when it comes to production, circulation, use, and deposition.

The flint axe remained an important object in the subsequent SGC, both in daily activities and in burials and hoards. As in the TRB, the axes from the SGC barrows were mostly small, used specimens that may relate to communal activities. Besides these ‘local elements’ we also find flint objects of exotic origin in SGC graves. These display a special biography and did not have a utilitarian function. It may be argued that these foreign, probably valuable, objects were instrumental in the construction of a specific sort of personhood. Flint axes also continue to figure in hoards. Many of the structural elements of depositing axes in wet contexts remained the same as during the TRB. Similar locations were selected for deposition and axes were treated with a red ochre paste. Yet, the actual biography of these axes is different: many were made on local flint and all of them were heavily used, something that was inconceivable in TRB depositional practices where hoards and graves were mutually exclusive categories. We are thus dealing with shifts in the system of selective deposition, in which some elements remain while others change.

In the BB culture, the first copper axes came into circulation. Flint axes became exceedingly



rare, even in settlement contexts and with one exception, flint axes do not appear in graves or in hoards. In fact, axes disappeared entirely from burial contexts as copper axes were exclusively deposited in waterlogged places. It appears that axes, whether of flint or copper, were not to be placed in graves at all. For the first time in almost a thousand years, flint axes were no longer regarded as appropriate elements for inclusion in either graves or hoards.

This paper has shown that axe blades were pivotal in the representation of systems of meaning in the prehistoric past. For well over a thousand years, flint axes formed part of a system of selective deposition, a system that underwent subtle changes with the passage of time. Just what these changes may have meant requires a detailed contextual approach that is beyond the scope of the current paper.

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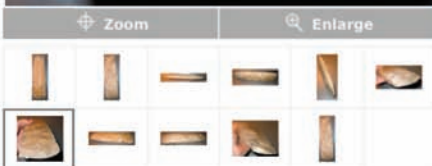
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●●● *It was a big site; developer-funded and pretty much all of it Roman or later. The crew were very professional but these things happen I suppose. Whatever, it was weird to see the axe lying unrecognised in the evaluation trench; pressed down into the clay by the weight of the machine; a bright and jagged strip where the bucket had dragged across its surface. ●*

Alison Sheridan,
Yvan Pailler,
Pierre Pétrequin,
Michel Errera



Old friends, new friends, a long-lost friend and false friends:

Tales from *Projet JADE*

Abstract

Our understanding of the production, distribution and use of Neolithic axeheads, adzeheads and chisels made of jadeitite and other rare Alpine rocks has been transformed by a major international French-led research project, Projet JADE. This has systematically recorded and mapped all such objects longer than 135 mm across Europe – extending its coverage to all artefacts of Alpine rock in Britain, Ireland and the Channel Islands, irrespective of length – and collating information about contexts, dating and depositional practices at a pan-European scale.

The research has involved a remarkable amount of work ‘behind the scenes’ in museums and private collections across the continent. This has led to new discoveries and to the challenging of old provenances and associations. Focusing on the results for Britain and Ireland, this paper highlights the new information that has been obtained on well-known examples and shows what else has been learnt from the project: the additional specimens, the remarkable stories of individual objects, and the need to be able to recognise ‘false friends’ – ethnographic objects and Neolithic specimens from elsewhere in Europe, collected by antiquaries.

Introduction

Since 2006, our understanding of the production, distribution and use of Neolithic axeheads, adzeheads and chisels made of jadeitite and other rare Alpine rocks has been transformed by a major international French-led research project, *Projet JADE*. Directed by Dr Pierre Pétrequin (of the CNRS and the Université de Franche-Comté at Besançon until 2009), and funded by the Agence Nationale de la Recherche, *Projet JADE* has systematically recorded and mapped all such objects longer than 135 mm across Europe – extending its coverage to *all* artefacts of Alpine rock in Britain, Ireland and the Channel Islands, irrespective of length – and collating information about contexts, dating and depositional practices at this pan-European scale. This has allowed it to compile a ‘materio-typo-chronology’, showing which types of axehead were manufactured of what material, and when each circulated between the late 6th millennium and the mid-3rd millennium BC in different parts of Europe. The resolution provided by *Projet JADE* makes it possible to track patterns of production and individual artefact biographies and itineraries as axeheads were roughed out, finished, and (in many cases) subsequently re-shaped and re-polished (see Pétrequin *et al.* this volume).

The Project has also successfully located the source areas, which are almost all to be found high in the Mont Viso and Mont Beigua massifs in the Italian Alps, not far from Turin and Genoa respectively (Pétrequin *et al.* 2007, 2008), and has applied the non-destructive analytical technique of spectroradiometry, adopted from the field of remote sensing, to establish a geological provenance for individual artefacts and to check whether they really are of Alpine rock (Errera *et al.* 2008). The exceptional nature of the source areas cannot be over-emphasised: we are dealing with mountains that may well have been deemed to belong to the realm of the supernatural and divine (see Pétrequin *et al.* this volume). Furthermore, the Project has clarified the *chaîne opératoire* and spatial organisation of axehead manufacture and, through experimental work, has demonstrated that it would take well over a thousand hours’ work to create a jadeitite axehead with a glassy polish as seen, for example, in *Figs. 1 and 3–5*. An extensive bibliography relating to the Project, along with abstracts of presentations from the international Project conference held in Besançon, September 2009, can be found at http://mshe.univ-fcomte.fr/documents/jade/jade_congress_abstracts.pdf; publications relating to its work on British and Irish



Fig. 1.
Jadeitite axehead
of Puymiroir type
from Canterbury.
Photo:
P Pétrequin/JADE

axeheads include Pétrequin *et al.* 2008; Sheridan *et al.* 2007; and Sheridan *et al.* 2010.

The final results of the Project are due to be published as two large volumes, and it is anticipated that the results for British, Irish and Channel Islands objects will also be more fully published in the *Proceedings of the Prehistoric Society*. In the meantime, this brief contribution is intended to highlight some of the many fascinating discoveries that have been made, and insights gained, from investigating British and Irish objects that have been claimed to be, or confirmed as being, of Alpine origin.

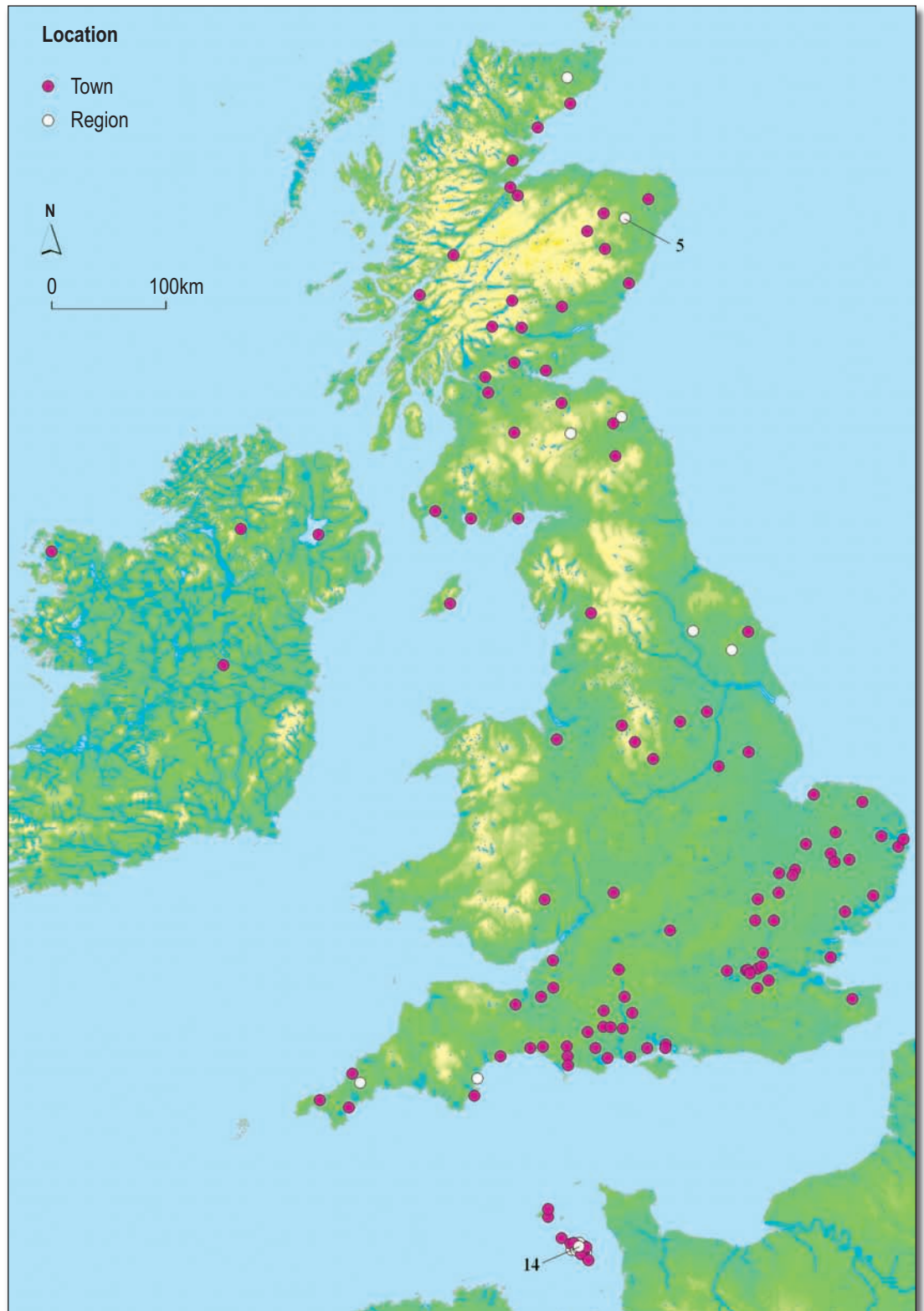
Old friends

Axeheads (and other objects) made from Alpine rock have long exerted a fascination over antiquaries, archaeologists and mineralogists in Britain and Ireland. Fine engravings are to be found in numerous nineteenth century publications (e.g. Evans 1872:fig. 1), and attempts to map and list British and Irish examples have been made since Lily Chitty prepared a distribution map for Sir Cyril Fox’s Presidential address to the Prehistoric Society of East Anglia, published in 1933 (p 154). By 1949, when Stuart Piggott and Terence Powell offered their updated map and list in discussing a fragment of an axehead which they had found at Cairnholly chamber tomb in south-west Scotland (Piggott & Powell 1949:121, fig. 9.1, 137–9 and Appendix A), the total had risen to 50 examples. In 2010, that figure has more than doubled, to around 118 (*Fig. 2*). Analysis of



Fig. 2.

Distribution of artefacts of Alpine rock in Britain and Ireland as of 2009 (open symbols indicate that findspot is known only to region).
Map: Frédéric Prodéo



specimens in order to identify the raw material has been undertaken since the late 1930s, when thin sections of several axeheads were made by the Sub-Committee on the Petrological Identification of Stone Axes of the South-Western Group of Museums (Keiller *et al.* 1941). Walter Campbell Smith, of the then-named British Museum (Natural History), undertook further

thin-sectioning and other types of analysis, reporting his results not only in Piggott and Powell's article but also in a set of three of influential reports in the *Proceedings of the Prehistoric Society* (Smith 1963, 1965, 1972), in which he revisited and corrected some previous identifications. Others were to continue with the listing and/or analytical work (Bishop *et al.* 1977;



Jones *et al.* 1977; Woolley *et al.* 1979), and individual finds of axeheads believed to be from the Alps have continued to be published (e.g. Cotton & Green 2004; Edmonds 2005; Field & Woolley 1983).

A major task of *Projet JADE*, as regards the British and Irish material, was to revisit the work of previous researchers who had been listing and mapping Alpine artefacts and to collect as many of these artefacts as possible for spectroradiometric analysis. This has been achieved for over 90% of the objects, with most of the remainder being unavailable for analysis or unlocatable, in private hands.

The Project has confirmed that most of the axeheads and other artefacts that had previously been claimed to have an Alpine origin are indeed of Alpine jadeitite, omphacite or eclogite. In particular, the thin, flat, triangular axeheads of so-called 'Altenstadt' and related 'Greenlaw' type, which are the commonest type to be found in Britain and Ireland (Fig. 3), all seem to be made from the finest, and rarest, type of jadeitite and many, if not most of these had originated in a restricted area high in the Mont Viso massif. Furthermore, by comparing each individual spectrum obtained from the spectroradiometric analysis with every other of the thousands of spectra obtained by the Project (from axeheads, raw material samples and working debris), it has been possible in some cases to trace the origin back to an individual free-standing block of jadeitite. Thus, in the case of a fragment of a Greenlaw type axehead from Dunfermline, Fife, it has been possible to demonstrate that it had most probably come from the same block on Mont Viso as three similar axeheads that have been found in northern Germany (Fig. 4).

Other insights provided by the Project include confirmation that some axeheads, like the Dunfermline example, must have been deliberately broken since jadeitite tends otherwise to shatter in an irregular pattern when it breaks naturally (incidentally, the fragment from High Peak in Devon [Fig. 5.3] has traces of an abortive attempt to perforate its butt, to make it resemble more closely the Morbihan axeheads of perforated Tumiace type). Some had been deliberately burnt as well as broken, as in the case of the examples shown in Fig. 5.3–6. This breakage and burning may well have been part of the rituals of deposition deemed necessary to return these precious, otherworldly objects to the world of the ancestors and gods.

That the process of deposition was a deliberate act, undertaken with regard to beliefs about the special status of Alpine axeheads, is



Fig. 3.
Examples of
Altenstadt (top) and
Greenlaw (bottom)
type axeheads.
Top:
Cunzierton,
Scottish Borders;
Bottom:
Greenlaw,
Scottish Borders.
Photos: NMS

suggested by the fact that at least 20 axeheads (c 17%) have been found in wetland contexts, including in rivers. Others have been found in topographically-distinctive locations, such as near the top of Ebbor Gorge in Somerset (Fig. 5.6). The best-known of these 'special' locations remains the Sweet Track, also in Somerset, beside which a Glastonbury-type axehead of quartzo-feldspathic jadeitite (whose origin is thought to be the Mont Viso massif) had been deposited, alongside an axehead of mined flint (probably from a south coast mine) in pristine condition, plus several carinated bowls (Coles *et al.* 1974). The construction of the trackway has been dated by dendrochronology to 3807/3806 BC and it seems to have been used for a short period, perhaps a dozen years (Hillam *et al.* 1990:218).

The Sweet Track axehead (which, like the Breamore example, may well have been reshaped, its original shape being a Chelles-type axehead) is of key importance in discussions of when and how Alpine axeheads reached Britain and Ireland. Like the aforementioned fragment of an Altenstadt/Greenlaw-type axehead found in the simple chamber tomb at Cairnholy, Dumfries & Galloway (Fig. 5 and Piggott & Powell 1949), it suggests that at least some of these axeheads had been brought from the Continent during the early



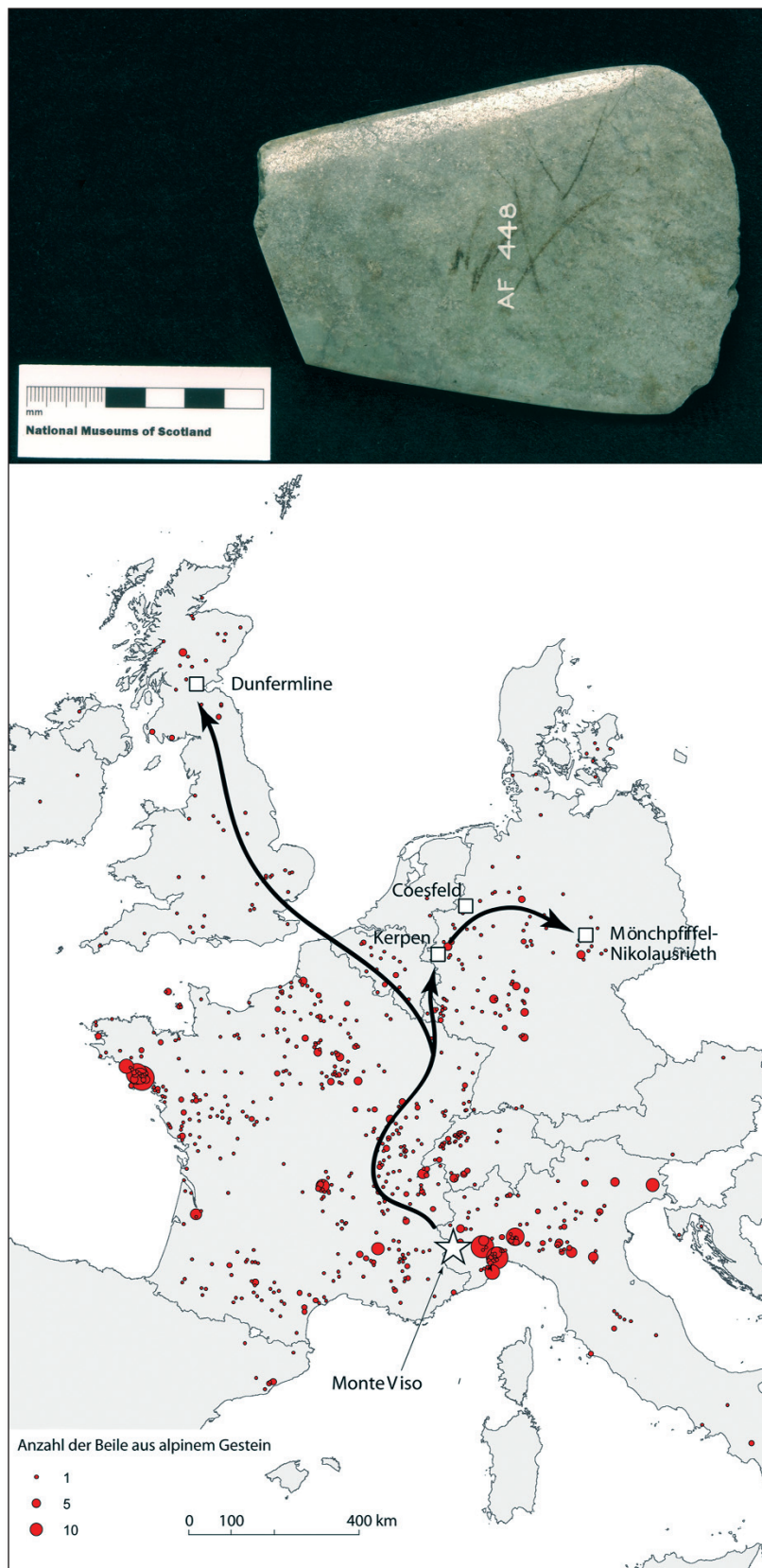


Fig. 4.

Fragment of Greenlaw-type axehead from Dunfermline, Fife, and distribution of other axeheads made from the same parent block of jadeite on Mont Viso.

Map: JADE; photo: NMS.

Note: the straight part of the broken edge is a petrological saw mark.

centuries of the fourth millennium, as part of the process of Neolithisation of Britain and Ireland. As argued elsewhere (Sheridan 2007; 2010; Sheridan *et al.* 2010), most are likely to relate to the 'Carinated Bowl Neolithic', a strand that involved movement from the far north of France to large parts of Britain and Ireland during the first centuries of the 4th millennium, while some – including the Breamore axehead and possibly also the Sweet Track example – may have arrived as part of the '*trans-Manche Ouest*' strand, from north-west France to southern and south-west England, around the same time (cf. Sheridan *et al.* 2008). We can say, from our knowledge of the chronology of axehead production (Pétrequin *et al.* this volume), that most may well have been at least two centuries old when they arrived, some considerably older; it seems likely that these had been the treasured possessions of incoming groups of farmers, handed down and carefully curated over many generations.

It would appear that most Alpine axeheads arrived within a narrow time frame during the early centuries of the 4th millennium. However, that some may well have arrived at a significantly later date is suggested by the two axehead pendants from Preston and Wootton Fitzpaine, Dorset (Fig. 6.1–2) and possibly also by two small double-ended chisels (Fig. 6.3–4), one found in an Early Bronze Age barrow at Brownstone Farm, Kingswear, Devon (Rogers 1947; Evens *et al.* 1972; Jones *et al.* 1977), and the other from an unknown location but possibly from Devon. The latter, which closely resembles the Brownstone Farm example, had been found by Canon Greenwell and is now in Torquay Museum, which suggests that it may have been found in the area; it is assumed to be contemporary with the Brownstone Farm chisel. The axehead pendants resemble those found in Late Neolithic contexts (according to French periodisation) in France and in the Channel Islands, and are likely to have been made during the late 4th or early 3rd millennium BC. This raises the intriguing possibility that there may have been cross-Channel contact between northern France and the south coast of England in the centuries around 3000 BC, as well as during the first quarter of the fourth millennium (see above and Sheridan *et al.* 2008) and in the centuries around 3600 BC (Peacock *et al.* 2010; Sheridan *et al.* 2010:31). The chisels are harder to explain in terms of cross-Channel contact, however, since artefacts of Alpine rock had long ceased to circulate over long distances on the Continent by the time these were in use. The Brownstone Farm example, of jadeite, has





Fig. 5.

Alpine axeheads that have been broken in prehistory; nos. 4–6 have also been burnt.

1:

Llangua, Wales;

2:

Aberdeenshire;

3:

High Peak, Devon (an abortive bore-hole was observed on the other side of the axehead fragment);

4:

Cairnholy, Dumfries & Galloway (note: the straight parts of the fracture edges are petrological saw marks);

5:

Railway Stores, Inverness, Highland;

6:

St. Cuthbert Out (top of Ebbor Gorge), Somerset.

Photos: 1–3 and 5: NMS;

4. P Pétrequin/JADE;

6. A Sheridan.



Fig. 6.

1–2: Axehead pendants;

1:

Preston, Dorset;

2:

Wootton Fitzpaine,

Dorset;

3–4: chisels;

3:

Brownstone Farm,

Kingswear, Devon;

4:

?Devon.

Photos:

P Pétrequin/JADE.



been radiocarbon-dated – from associated cremated bone – to 3420 ± 30 BP (SUERC-21367, 1870–1630 cal BC at 2σ , calibrated using OxCal v.4.1). By that late stage, jadeitite had long fallen out of fashion, the last examples of its use dating to around 2700 BC in the distant lake settlement site of Clairvaux-les-Lacs in the French Jura. The Brownstone Farm evidence raises the question of how the Alpine stone had been obtained: are we dealing with the local, Early Bronze Age reshaping of an ancient axehead that had been discovered locally? The object shows no obvious signs of this. As for the second chisel, found by Greenwell, not only is its findspot uncertain, but also its identification as being of Alpine rock is not definite, with the initial provisional identification as eclogite currently being checked against the *Projet JADE* database of spectra. If it is indeed of Alpine eclogite, then in order to explain it one would have to postulate that a *second* ancient axehead had been found and reworked – an interpretation that the authors

find unconvincing. All that one can conclude for the moment is that more remains to be found out about both these objects.

Attention should also be drawn to three Alpine axeheads with particularly interesting histories. The first (*Fig. 7*) was found in 1780, as workmen were preparing the foundations for the new St. Enoch's Church in Glasgow, beside the River Clyde (Smith 1963:167, no.54). Early accounts suggest that it had been found in a logboat, and there is no way of checking the validity of this claim, although it could be genuine. The axehead was reportedly acquired 'by a maternal relative of C. Wilson Browne's [the owner during the mid-1800s] "who chanced to be passing at the time of the discovery"' (*ibid.*) and is now the property of Glasgow Museums, on display at the St. Mungo Museum of Religious Life and Art. This exquisite black axehead of Durrington type, made of eclogite from the Bulè Valley, Mont Viso, has a unique pattern of glassy polish, with an unpolished band



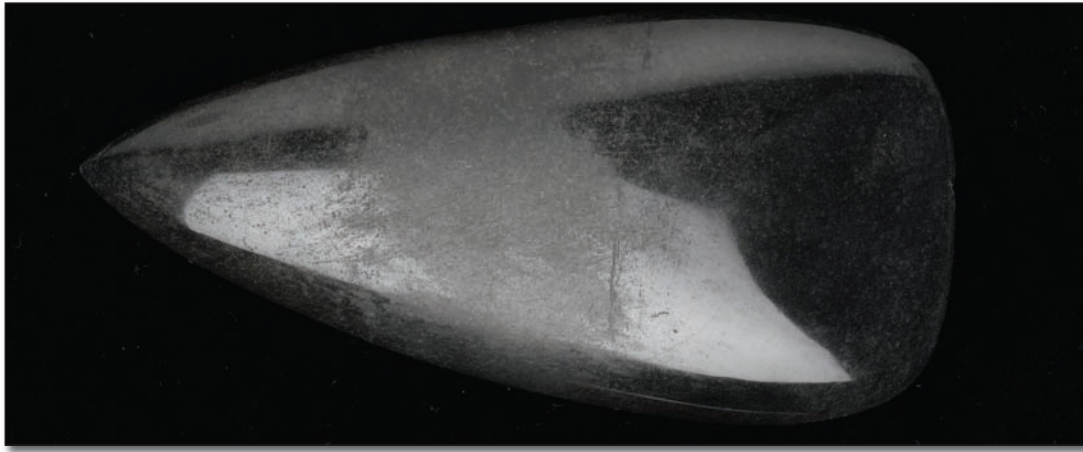


Fig. 7.

Durrington-type axehead of eclogite, said to have been found in a logboat beside the River Clyde, Glasgow, with glassy polish at either end and an unpolished band at the position of the haft.

Photo: NMS.

around its mid-point. This, and the shape of the boundary between unpolished and polished zones, indicates that the axehead must have been given its brilliant polish when set in a wooden haft. This feature is unique among the c 1800 axeheads studied by the *Projet JADE* team across Europe. Elsewhere, where a varied surface texture exists (in the hoard of Bégude-type axeheads from its eponymous findspot: Pétrequin *et al.* 1998:fig. 4), this is due to the deliberate roughening of the surface, in order to prevent the heads from slipping out of the haft. The presence of a glassy polish is a characteristic feature on some Alpine axeheads, and it is known to have been applied at some considerable distance from the source area of the rock. British and Irish axeheads are unusual in having a particularly high incidence of this surface finish, and this has led to debate within the *Projet JADE* team as to where, when and why

this had been applied. While it seems likely that the axeheads that had passed through the Morbihan during their long itinerary had probably received this special polish there, with other axeheads it seems most likely – at least in the opinion of the first-named author – that the polish was applied in northern France, shortly before the perilous sea journey was undertaken to an uncertain new life in the north (i.e. in Britain and Ireland). If one accepts that these non-utilitarian axeheads had been attributed special powers (e.g. to protect), then their polishing to a glassy sheen would be a logical practice, probably intended to enhance their apotropaic quality. Quite why the St. Enoch's Church axehead had not been removed from its haft while this was done, we shall never know; perhaps it was stuck.

The second axehead of particular note (Fig. 8) is one that may have been found in Scotland;



Fig. 8.

Altenstadt-type axehead of jadeitite, perforated and mounted in silver during the 19th century and worn by a Scottish officer as a 'cure' for kidney disease.

Photo:

P Pétrequin/JADE.





Fig. 9.

1:

Altenstadt-type
axehead of jadeite,
probably from Traquair
Estates, Scottish Borders,
and its case;

2:

The case alongside
other contemporary and
similarly-decorated cases
from Scotland.

Photos: NMS.

we know of it through a reference in G F Kunz' 1913 book, *The Curious Lore of Precious Stones*, where it is stated (in a figure caption facing p. 264) that it had been worn by a Scottish gentleman during the 1860s, tied over his loins, as a 'cure' for kidney disease (cf. Smith 1963:169, no. 66, where it also states that the man had been an officer). It is of Altenstadt type, of jadeite from Mont Beigua, and clearly its 19th century owner had arranged for two holes to be drilled near its ends, and for it to be embellished with a silver mount, so that it could be worn rather like a sporran. This belief in the power of this precious green stone to heal kidney problems is widespread and long-lived: as Kunz pointed out, 'The name jade is derived from the Spanish designation, *piedra de ijada*, meaning literally "stone of the flank", which is said to have been bestowed upon the stone because the Indians [of south America] used it for all diseases of the kidneys. The name nephrite owes its name to the same idea.' (Kunz 1913:383). Such ideas were widespread, and can be compared with the traditional popular belief, prevalent until the 19th century, that flint arrowheads were 'elf bolts', to be used as charms (Cheape 2008:114–5).

The third axehead featured here (Fig. 9.1; Smith 1963:65) might also have been the subject of beliefs, in the last few centuries, as to its curative or protective properties. On display in Traquair House in the Scottish Borders, this magnificent Altenstadt type axehead of jadeite

may well have been found on the extensive estates of the Maxwell Stuart family in south-east Scotland. A fine decorated leather carrying case had been made for it, and as a result of investigations by Robert Stevenson (Keeper of the then-named National Museum of Antiquities of Scotland) in 1954 with a colleague from the National Library of Scotland (NLS), it was then believed that the case may have been made in France during the early 18th century, raising the suspicion that the axehead may have been acquired there. The Maxwell Stuart family had spent some time in France during the 18th century. However, in 2007 the principal author of this contribution undertook renewed investigations, consulting rare book curators in the NLS (Dr Brian Hillyard and Eoin Shalloo) and colleagues in the Scotland and Europe Department of National Museums Scotland (NMS, George Dalglish and Godfrey Evans). From this it was concluded that the box is more likely to have been made in Scotland, and to date to around 1700; the punched designs on the box are indeed of French inspiration, but executed less expertly than is the case with genuine French bookbindings. It is likely that an Edinburgh-based bookbinder who had learned his craft in France made the box; indeed, in the NMS collections there are two other roughly contemporary objects with very similar punched designs (Fig. 9.2–3): one is a carrying case for a jewel, made for the Carruthers family of Holmains, not far from Traquair House, and the



other is a case for calling cards. This discovery lends support to the idea that the axehead had been found in south-east Scotland, where several other similar jadeitite axeheads have been recovered. George Dalgleish has added (pers comm) that the practice of housing individual jewels and precious objects in specially-made boxes during the 17th and 18th centuries was not simply to protect them, but may have indicated that they were particularly revered, and perhaps believed to have special powers: a parallel may be cited in the housing of some religious relics in similar containers in the Vatican. Irrespective of whether the Maxwell Stuart family accorded special powers to the axehead three centuries ago, the fact that the Traquair House axehead has been treated with such care offers an early example of fascination with these beautiful objects.

New friends

During the course of *Projet JADE*, the list of Alpine axeheads in Britain and Ireland has been augmented in two main ways: firstly, through the systematic inspection (by one of us, YP) of several museum collections, followed by spectroradiometric analysis of candidate specimens; and secondly, through the reporting by members of the public of new discoveries, or of examples held in private collections, thanks to the publicity generated by the Project.

The systematic inspection of several museum collections has unearthed several 'new' examples which, because of their small size or the fact that they are not of the commonest (and distinctive) flat triangular shape, means that they had previously evaded notice. These include a teardrop-shaped 'Durrington' type axehead of jadeitite in the collections of Marischal Museum in Aberdeen (ABDUA: 35465). This is shown in *Fig. 10*, beside two axeheads of strikingly similar shape and size, but of non-Alpine rocks (ABDUA: 19825 and 19988). While the exact provenance of these axeheads is unknown, all could have come from north-east Scotland: the Alpine example is recorded as having been found in 'Aberdeenshire', while ABDUA: 19825 is from 'Scotland' and ABDUA:19988, from Inverurie, Aberdeenshire. It also seems likely that the two non-Alpine examples represent deliberate copies of the Alpine axehead type – a phenomenon known from elsewhere on the Continent (e.g. in the 'Cangas' type axeheads of north-west Spain, made to resemble perforated examples of 'Tumiac' type from the Morbihan area of

Brittany). The discovery of the previously-unrecognised Alpine axehead in the Marischal Museum collection was followed by a subsequent discovery, by curator Dr Neil Curtis, of a fragment of a large and previously-unrecorded Altenstadt axehead of jadeitite in the same collection (ABDUA:64546). This serves to illustrate that, despite all the previous studies of stone axeheads (e.g. by the Implement Petrology Group/Committee: Clough & Cummins 1979, 1988), hidden treasures may yet lurk in museum collections, and that thorough re-examination, in the light of our current understanding of the range of Alpine axehead materials, shapes and colours, can pay dividends.

As regards Irish Alpine axeheads, the work of *Projet JADE* was significantly facilitated by the systematic research on all Irish stone axeheads that had previously been undertaken by the Irish Stone Axe Project (ISAP, Cooney & Mandal 1998). This had identified around 15 unusual axeheads with Irish findspots, suspected to be of jadeitite or nephrite, or previously identified as such by previous researchers (e.g. Smith 1963, 1965, 1972). Re-examination of most of these (by YP), followed by selective spectroradiometric analysis, confirmed that the best-known examples (namely the Altenstadt/Greenlaw specimens from Tristia, Co. Mayo; Kincraig, Co. Donegal; and Paslickstown, Co. Westmeath) are indeed of Alpine jadeitite; that some – e.g. two, in the NMS collection, reportedly found 'on the banks of the River Shannon' – are in fact ethnographic specimens (see

Fig. 10.
Durrington-type
axehead of jadeitite (*far left*),
plus copies in local rock,
in Marischal Museum,
Aberdeen.
Photo: Neil Curtis.





Fig. 11.

1:

Puy-type axehead,
Potterhanworth Fen,
Lincolnshire

(photo:

P Pétrequin/JADE);

2:

Fragment of
newly-found axehead,
Pentridge Down, Dorset
(photo: Angela Farmer).

Fig. 12.

Axehead from Garvock,
Aberdeenshire.

(Photo:

Moesgård Museum).

A long-lost friend: the axehead from Garvock, Aberdeenshire

One Alpine axehead that came to the authors' attention as a result of *Projet JADE* is a very fine Altenstadt axehead of jadeitite, probably from the Porco valley on Mont Viso, and found at Garvock, Aberdeenshire (formerly Kincardineshire: Fig. 12; Kaul 1998:44; Jensen 2007:132). This specimen is housed in the Nationalmuseet, Copenhagen, where it had acquired an incorrect findspot name of 'Garsack' at some time in the past. It was included in *Projet JADE* thanks to research by team member Lutz Klassen, with the kind co-operation of Flemming Kaul at the Nationalmuseet. This particular specimen has had an interesting his-

below, 'false friends'); and others are most unlikely to be of Alpine rock. One – a small example, provenanced only to 'Ireland' – has turned out to be of Alpine rock; and it seems likely, from the ISAP photograph of an axehead from Movagh, Co. Derry, from the Keiller-Knowles collection, that this, too, is of Alpine rock (the item in question could not be located).

The public response to articles, lectures and newspaper coverage of *Projet JADE* has turned up several hitherto unknown Alpine examples, along with other axeheads that have turned out not to be of Alpine rock. The former include a Puy-type axehead of jadeitite found around 1975 in Potterhanworth Fen, Lincolnshire (Fig. 11.1), whose closest compositional links are with raw material samples from Mont Beigua; and a burnt fragment of an axehead of probable Altenstadt/Greenlaw type, of jadeitite almost certainly from the Porco valley, Mont Viso, found in February 2010 during fieldwalking on Pentridge Down, Dorset (Fig. 11.2). The Potterhanworth Fen example is of the latest type of Alpine axehead to have circulated widely across Europe and had probably not been as old as the other Alpine axeheads when it was finally deposited in its wetland context; this kind of axehead was being produced in large numbers around and after 4000 BC, its faceted sides probably influenced by the shape of early copper axeheads (Pétrequin *et al.* this volume). The Pentridge Down axehead fragment joins the cluster of Alpine axeheads from Wessex (Sheridan *et al.* 2010:fig 6), which includes a further recent find, a small Chelles type axehead of eclogite from Handley Common, Dorset.



tory over the past 150 years, as it was acquired by the famous Danish antiquary J. J. A. Worsaae during his visit to Scotland in October 1846, from whose collection it found its way into the Nationalmuseet. Worsaae acquired the axehead from Scottish antiquary Charles Kirkpatrick Sharpe (c 1781–1851), who lived in Edinburgh, was a friend of Sir Walter Scott, and is reputed to have had one of the finest collections of antiquities ever to be accumulated by a private individual in Scotland. The inclusion of this axehead in *Projet JADE* has served not only to correct its misattribution to a non-existent findspot, but also to bring this long-forgotten Scottish axehead to the attention of British archaeologists. It joins the cluster of Alpine axeheads that have been found – or are alleged to have been found – in north-east Scotland (Fig. 2 and see below).

False friends

Just as *Projet JADE* has succeeded in identifying previously-unrecognised Alpine axeheads, so it has also been able to disprove an Alpine origin for some specimens that had previously been attributed to that source. This is particularly true as regards axe- and adzeheads made from nephrite, where every confirmed British and Irish example examined to date can be accounted for as being a recent ethnographic ‘manuport’, brought back from distant travels (e.g. by Victorian missionaries, engineers, *et cetera*), rather than as a Neolithic object made from nephrite from the Valais region of Switzerland (even though such objects are known to exist, mostly in that region). One such ethnographic specimen is the irregularly-shaped axehead found under a rose bush in a garden in Hendon, north-west London (Fig. 13.1), which was published in 1977 as being “probably of Alpine jadeite” (HADAS 1977; cf. Jones *et al.* 1977:293, where the material is correctly identified as nephrite). This object finds no convincing match, either in its material or form, among the c 1800 large Alpine axeheads studied by *Projet JADE*. Instead, the distinctive, foliated green stone can be matched in New Zealand, where nephrite (*pounamu*) has traditionally been prized. Although axeheads of this material are relatively uncommon there, being outnumbered by adzeheads (Best 1974), it is possible to find parallels for the Hendon axehead in New Zealand. Finds from urban gardens tend to be suspect, as they can easily represent material that had been collected and then discarded, as seems to have been the case

with this axehead (as with one found in Warkworth Terrace, Cambridge in 1908, which turned out to be from the West Indies: Smith 1963:170, A).

Some ethnographic manuports have turned up in the most unexpected places and one can only assume that these, too, represent material that had been collected and then discarded. A classic Maori adzehead (Fig. 13.2) of nephrite was found on an islet in the River Thames, during the construction of a railway bridge, at Strand-on-the-Green, Chiswick (Adkins & Jackson 1977:43; see Best 1974:plate XVIII.37, for a New Zealand *comparandum*). Elsewhere along the Thames, at Datchet, an amphibolite axehead (Fig. 13.3) that was reportedly found with other stone axeheads in dredgings was found to be from Woodlark Island, and of a type used in the *kula* exchange system (*inter alia*) in the Trobriand Islands of Papua New Guinea. Similarly, deep in the countryside, another amphibolite *kula* axehead from Woodlark Island turned up on a farm at Droxford, Hampshire (and was published as being of ‘jadeite’: Schofield 1987). Even though the publication stated that it had been found during construction work, a few centimetres below ground level in a previously undisturbed area, further enquiries of its owners in 2008 revealed that this account was not accurate, and that the object had actually been found in a barn. Once again, this seems to be an ethnographic object which had been discarded by previous occupants. More puzzling is the nephrite or serpentine axehead (Fig. 13.4) that was found on Dartmoor, at Lower Down near Bovey Tracey in 1930, when a new path was being cut ‘through a mound of unknown character, and a few feet from an ancient trackway...’ (Anon 1932; Smith 1963:158). Of strikingly similar material to the Hendon axehead, its most likely origin is New Zealand or New Caledonia. Could it be that this had been the possession of a sailor?

Ethnographic manuports evidently also lurk, mis-attributed, in some museum collections, including those of National Museums Scotland. Here, two small axeheads that are catalogued as having come ‘from the banks of the [River] Shannon’ (as if from dredging) and acquired, with four others from the same reported Irish provenance, in 1903, were found to be of nephrite, probably from New Zealand or New Caledonia. (Fig. 14.1; NMS X.AG 411, 415). Unfortunately, the NMS records offer no further information about their discovery, nor do the pages of the *Proceedings of the Society of Antiquaries of Scotland*, and we may never know





Fig. 13.

'False friends'.

1:

Nephrite axehead
from New Zealand,
found in Hendon;

2:

Maori adze,
nephrite, from
Strand-on-the-Green,
Chiswick, London;

3:

Amphibolite axehead
from Woodlark Island,
dredged from the
Thames at Datchet ;

4:

Nephrite axehead
from New Zealand or
New Caledonia found
near Bovey Tracey, Devon.

Photos:

1, 3, 4: P Pétrequin/JADE;

2: Museum of London.

whether this is a case of mis-labelling of a mixed collection of material or whether, as with the Thames axeheads, we are dealing with ethnographic objects that had been thrown away in the Shannon.

The accidental mis-labelling of material is a perennial museum problem, especially where the material in question has passed through several hands or where old collections are concerned. Thus, for example, the small amphibolite axehead in the Wiltshire Heritage Museum, Devizes, 'Believed to be No. 11 of [Sir Richard Colt Hoare's] Stourhead Collection dug up at the entrance to Scratchbury Camp [Norton Bavant, Wiltshire] by Mr Cunningham' (Smith 1963: 171, F), is of a type and material that is unmistakably Australian (DZSWS:STHEAD.11). Indeed, Campbell Smith remarked that the Stourhead Collection was not confined to British antiquities (*ibid.*), and he listed that axehead in his Appendix of examples that had previously, and wrongly, been reported as being of Alpine material. However, elsewhere in the same report (p. 164, no. 40), Smith includes as genuine another small axehead allegedly from Broad Town, Wiltshire, housed in the (then-named) British Museum (Natural History). Identified as 'black amphibole' by Evens *et al.* (1962: no. 845) and as unusually-black nephrite by Smith. The *Projet JADE* team were able to

identify this axehead as a New Caledonia specimen, of amphibolite, close to nephrite. In this case the mis-labelling may have occurred because the object had been donated to the museum after the death of its collector, by his widow.

While ethnographic objects can be relatively easy to spot if one is well acquainted with other material of known provenance, it can be harder to recognise Continental archaeological objects of Alpine stone which had been acquired, usually from Swiss lake settlements, by collectors and museums during the late 19th and early 20th century and subsequently mis-labelled as having been found in Britain or Ireland. This appears to have been the case with one small axehead in the Yorkshire Museum which, through no fault of the current staff, seems to have suffered 'provenance drift'. Labelled simply as 'Ireland' (YORYM 2001.1077), the small axehead in question (Fig. 14.2) matches exactly the small axeheads found in Alpine and peri-Alpine lake settlements. Furthermore, recent research by Mark Edmonds has revealed that the Yorkshire Museum, like many others in Britain and Ireland, acquired a sizeable number of Swiss lake village artefacts, in this case as part of the 'Boynton Collection', amassed in the latter part of the 19th century. Given the rarity of Alpine axeheads in Yorkshire, it seems likely



that the axehead in question had been acquired as part of this material (Edmonds pers comm).

A final example of a 'false friend' relates to the wristguard from Sonning, Berkshire (Fig. 14.3), which had been petrologically identified as being of nephrite (through thin-section petrography) by J E Morey during the 1960s (Evens *et al.* 1972:244) – with the implication being that it could have come from the Alps. Thanks to research undertaken by a team of archaeologists, petrographers and geochemists for a current project on Early Bronze Age grave goods (Woodward *et al.* 2006), 24 wristguards of the same distinctive, pale material – some with a bluish tinge – have now been recognised. All of these were examined macroscopically and most analysed using portable X-ray fluorescence (XRF) spectrometry by Woodward's team. At first it was thought that the unusual material employed was spotted slate or hornfels, but comparing the results of X-ray diffraction and XRF analysis with spotted slate samples proved this not to be the case, and the materials are identified as amphibole-bearing metasediments (amphibolites). The sources for such rock are currently unknown, but field research continues. Following examination of three of these wristguards (including Sonning) in thin section, their material was confirmed as being of a very fine-grained amphibolite comprising fibrous amphibole, quartz and sphene, which is certainly *not* an Alpine nephrite. The same conclusion was drawn from the spectroradiometric analysis of six of the wristguards (again, including Sonning).

Conclusions

It is hoped that this brief review of some of the results of *Projet JADE* has demonstrated the rich dividends that have been reaped from this remarkable exercise in international collaboration. It is only by studying the phenomenon of Alpine artefact production, circulation and use at a pan-European scale that it can begin to be understood. Studying large numbers of axeheads also allows anomalies (such as recent ethnographic manuports) to be identified more easily.

As far as the British and Irish specimens are concerned, it can be claimed that our understanding has been transformed by the new information produced by *Projet JADE*. The very fact that we can now pinpoint the ultimate source of the rock used for many individual axeheads, and recognise far-flung products from individual jadeitite boulders in the Italian Alps,

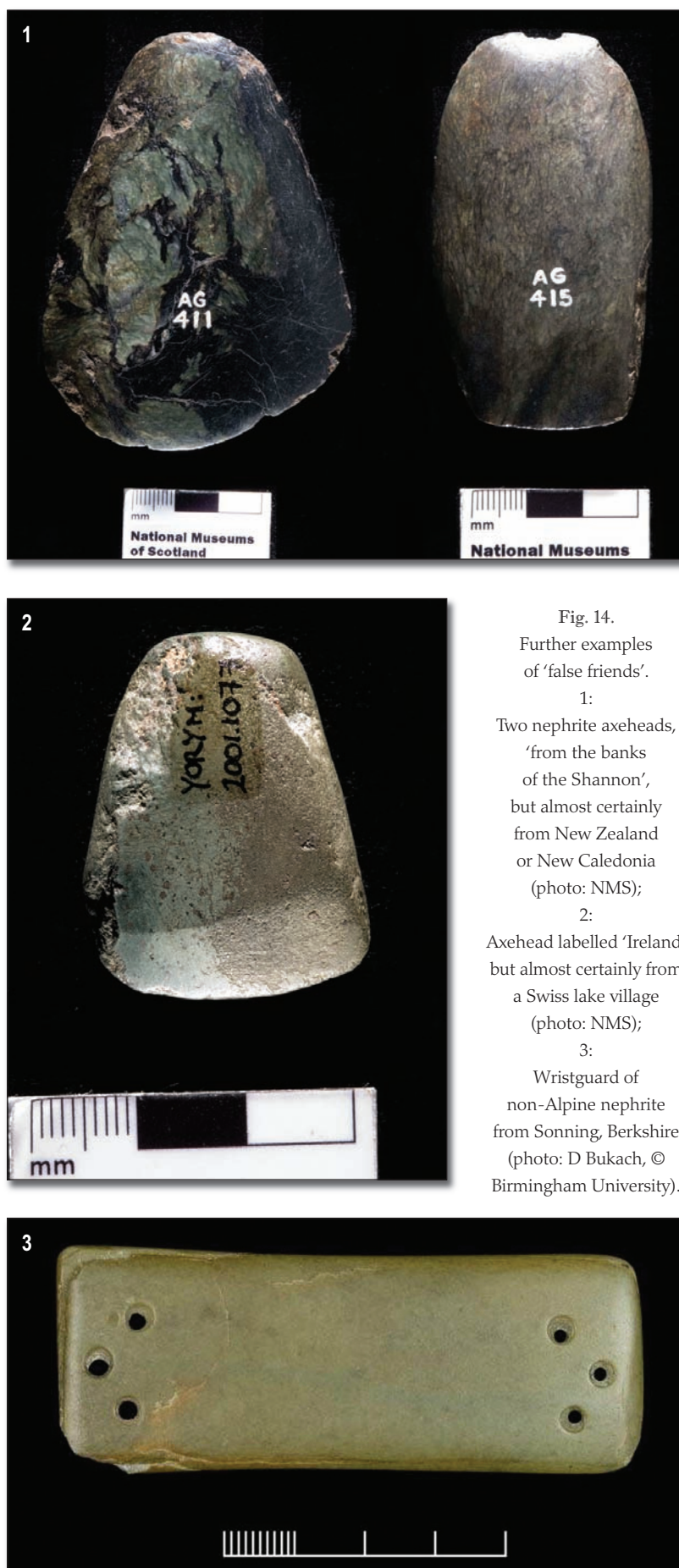


Fig. 14.
Further examples
of 'false friends'.

- 1:
Two nephrite axeheads,
'from the banks
of the Shannon',
but almost certainly
from New Zealand
or New Caledonia
(photo: NMS);
- 2:
Axehead labelled 'Ireland'
but almost certainly from
a Swiss lake village
(photo: NMS);
- 3:
Wristguard of
non-Alpine nephrite
from Sonning, Berkshire
(photo: D Bukach, ©
Birmingham University).



represents the achievement of a long-held aspiration. Because of this, our axeheads can now be understood within a broader geographical and chronological context. Furthermore, the collaborative work involved in tracking down, researching, borrowing and analysing the British and Irish (and Channel Island) material has yielded new information regarding the findspot location, and the circumstances of discovery and of acquisition, of several axeheads, as well as unearthing previously-unrecognised specimens. It has also reminded us of some of the pitfalls and problems involved in such a study, especially where poorly-provenanced material is concerned. We need to familiarise ourselves with ethnographic axeheads, with archaeological material imported from the Continent through antiquarian and other collecting activity, and with the history of museums' collecting; and we do need to check the reliability of findspot and contextual information, wherever possible.

Loose ends remain to be tied up: the search for hard-to-find privately-held axeheads will continue, for example, and the task of matching each individual spectroradiometric result with all the others has not yet been completed. In the case of axeheads that *Projet JADE* has shown not to have had an Alpine origin, there remains the question of where the source of the stone is to be found. It would be particularly useful to 'bottom out' the question of whether stone from south-west England had been used to manufacture the axehead from a Neolithic causewayed enclosure at Raddon, Devon, for example (Gent & Quinnell 1999:53).

Projet JADE has had a remarkable impact on the discipline, but it offers broader lessons too. Without doubt, part of the success of this work has been because it has had a high public profile in the media. This has stimulated interest and has also encouraged new discoveries. The work reported here has also demonstrated how useful and powerful the non-destructive technique of spectroradiometry is. With this, and other new characterisation techniques that are now coming on-line, we will be able to return to our collections of other materials with new and more detailed questions.

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The kind co-operation of a huge number of individuals, from museum curators and field archaeologists to private owners of axeheads, is warmly acknowledged; the number of people involved is too large for each person to be named individually. Special thanks are extended, however, to Gill Varndell and her colleagues in the British Museum for kindly hosting *Projet JADE*'s 2008 session of analysis; and to Ann Woodward and Rob Ixer for providing up-to-date information on their research on wristguards, along with the photograph of the example from Sonning. Finally, the Editors are thanked for their forbearance.

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The Irish Stone Axe Project:

Reviewing progress, future prospects

Abstract

This paper details the character and progress of the Irish Stone Axe Project (ISAP) since the early 1990s. It offers a review of research to date and summarises many of the conceptual and methodological concerns that have arisen since work began some twenty years ago. A detailed discussion of the project database provides a point of departure for two short case studies which together demonstrate the value of a more holistic approach to stone axe studies, in which questions of morphology and context can be set systematically alongside the characterization and sourcing of raw materials. The current state of knowledge is summarised and broader archaeological implications are explored, particularly for the Early Neolithic. The paper concludes with thoughts on prospects for future research directions.

Introduction

Twenty years after the beginning of the project, twelve years after the publication of a monograph that was intended to be the first in series but when the second volume has still to appear (Cooney & Mandal 1998; forthcoming), seems like a good time to critically review the progress and prospects of the *Irish Stone Axe Project* (ISAP). Following on a review of the work of ISAP to date this paper offers a detailed discussion of the central platform of ISAP, the database, which will be online early in 2011. Two case studies are used to demonstrate the approach and work of the project; fine-grained sedimentary sources of axeheads, and the quarry at the Eagle's Nest on the island of Lambay off the east coast of Ireland where porphyritic andesite (porphyry) was exploited for axehead production. There is a comment on the significance of the occurrence of axeheads in early Neolithic contexts and a discussion of future prospects.

ISAP work to date

The Irish Stone Axe Project (ISAP) was set up in 1990 by Gabriel Cooney and Eoin Grogan, arising out of their interest in stone axe studies and its research potential (e.g. Cooney 1987, 1989; Grogan 1989). The publication of a preliminary distribution map of stone axeheads in Ireland (Grogan & Cooney 1990) was followed by a review paper (Sheridan *et al.* 1992). This discussed the history of stone axe studies in Ireland, the state of research up to the beginning of the 1990s and introduced ISAP. The 1990s could be characterised as the initial, very active phase of the Irish Stone Axe Project, made possible and sustained by multi-year funding from the Heritage Council.

In this period, ISAP produced county (e.g. Cooney *et al.* 1990; Cooney *et al.* 1992) and regional level reports (Cooney *et al.* 1999). The progress of the petrological research, including methodological developments, was reviewed (Mandal *et al.* 1991/2; Mandal & Cooney 1996). Cooney & Mandal (1995) discussed the range of lithologies used to make stone axeheads, including the role of porcellanite as a source (for earlier work see Jope 1952; Morey & Sabine 1952; Sheridan 1986; Mallory 1990) and the recognition of a significant movement of axes across the Irish Sea during the Neolithic. The ISAP petrologist completed his doctoral research in 1996 (Mandal 1996a) and published an overview discussing gabbro axeheads as a

case study (Mandal 1997). Work continued on porcellanite, including the significant contribution of the identification of a geochemical discriminant for products from the two known porcellanite sources in County Antrim; Tievebulliagh and Brockley (on Rathlin island) (Meighan *et al.* 1993; Mandal *et al.* 1997). The first ISAP monograph was published in 1998. This presented the results of the work of the project to date and used the examination of the occurrence of tuff ('Irish Group VI') axeheads in Ireland to demonstrate the integration of archaeological and petrological research that characterises the ISAP approach (Cooney & Mandal 1998).

The last ten years has seen a more low-key phase during which recording has continued. The number of axeheads on the ISAP database has risen from the 19,800 figure used in Cooney & Mandal (1998: e.g. table 3.1) to 21,471 (March 2010). Cooney & Mandal (2000) provided a review of ISAP to date and Cooney (2000, 2008) discussed how the results of the project inform our understanding of the Neolithic in Ireland. A significant number of the newly recorded axeheads in this period came from archaeological sites, excavated during what was the peak period of development-led archaeology in Ireland. The project continues to provide site reports (e.g. Mandal 2007, 2008). The additional data gathered on axe hoards by ISAP provided the context for a comparison of stone and bronze axehead hoards in Ireland (Cooney 2004a). The results of the excavation of the stone axehead quarry site at the Eagle's Nest on Lambay (Cooney 2005, 2009a, 2009b), carried out in the context of the project, provided the impetus for wider discussion of such quarries in Ireland and Scotland (Cooney 2004b). The results of ISAP also facilitated reassessments of earlier work (e.g. Leon 2005) and contributed to international projects, specifically project JADE (Pétrequin *et al.* 2008a) and the dating of the early Neolithic in Britain and Ireland (Whittle *et al.* forthcoming). Experimental manufacture and hafting of axeheads of a range of lithologies was undertaken (Mandal *et al.* 2004). More popular accounts discussing the significance of stone axeheads have been published (Cooney 2003, 2009a; see also Mandal 1996b). In 2006, a grant from the Irish Research Council for the Humanities and Social Sciences (IRCHSS) provided the impetus to develop a web portal for the ISAP database (*Iaxe*) and has facilitated a critical re-appraisal of the database (see below).



The Irish Stone Axe Project database

The aim of ISAP articulated by Cooney & Mandal (1998:1) still remains: to establish a data-base incorporating contextual, morphological and petrological information on all known stone axeheads with an Irish provenance. A relational database (constructed using 4th Dimension software) is used to record axeheads. There are two main types of entry field used: the free-text field which allows the user to enter information, the quality and quantity of which may vary considerably from one axehead record to the next; and the lookup-text field where the user must select a value for entry from a pre-populated list. This data structure enables rigorous data collection through pre-defined parameters, while also allowing axehead-specific detail recording and easily-definable cross-querying of the ISAP dataset.

In broad terms ISAP records three distinct types of data for stone axeheads: contextual, morphological and petrological. This dataset is complemented with axehead photographs, drawings and bibliographic references. A detailed description of the ISAP methodology and individual data fields has been published elsewhere (see Cooney & Mandal 1998).

The *contextual data* recorded for each axehead consists of information relating to the axehead's current location and museum reference numbers; the axehead's discovery location and circumstances; and the archaeological context of the axehead, where applicable. Due to the nature of the evidence, a significant portion of contextual data is recorded in free-text fields. This enables flexible recording of highly variable data such as museum accession numbers and townland (the smallest administrative unit in Ireland) names. Where predictable aspects of the archival data are recorded, such as county or museum collection names, a pre-populated drop-down field is used to maintain data standards and integrity.

The *morphological data* relating to axeheads consists of two broad categories. The first describes the type and condition of the axehead, for example, whether it is an axehead or adze, whether the axehead is complete or not and the stage of the axehead within the *chaîne opératoire*. The second consists of descriptions of recognisable attributes and empirical measurements of the dimensions. Attributes are recorded based on pre-defined image and textual templates of, for example, face shape, cross section shape and blade profile. This image-based analysis is complemented by the record-

ing of pre-defined textual attribute descriptions of, for example, hafting evidence or primary production mode. The pre-defined attribute recording is further elaborated on with a free-text description of the axehead which is complementary to the attribute analysis.

The *Petrological data* collected through macroscopic and microscopic methods (e.g. Mandal 1997; Cooney & Mandal 1998:25–26 and appendix 2) are recorded in free-text fields to allow a degree of flexibility in the process. Macroscopic and microscopic identifications are used to assign textual rock type identifications and geochemical analyses are represented by numerical trace element data (see Mandal 1996a).

The ISAP dataset now has a relatively long history of collection which has resulted in a number of issues with the entry of data. The addition of fields over time has resulted in some data areas not being as complete as others. For example, recognition of the significance of the numbers of axeheads coming from well defined and dated contexts over the last decade (e.g. Danaher 2007; Kelleher 2009) led to a re-design of the relevant section of the dataset. Within the contextual data table of the database the 'archaeological excavation' section now records relevant contextual details of an excavated axehead, for example: archaeological site type, site details, associated features, associated artefacts and organic dates. But this 'archaeological excavation' section is a relatively recent addition to the database. Therefore, there may be axehead entries in the database, where the axeheads were discovered from older archaeological excavation, that do not have this data recorded.

The dataset

This section briefly highlights some of the aspects of the data that have been recorded by ISAP. There are currently (March 2010) 21,471 axeheads recorded by in the ISAP database. It is intended here to outline some of the detail regarding these records.

Contextual and spatial data:

Each record in the ISAP database is issued a unique identifier number (sequence number). The museum reference number(s), collection title and current location is recorded for each axehead. An example of this data recording are the 13,203 axeheads that are assigned to known museum collections (primarily the National Museum of Ireland and the Ulster



Museum, but there are also significant collections in a number of other museums, particularly in the UK).

One of the most important aspects of the database is the spatial recording of axeheads for use in distribution analyses. Of the 21,471 axeheads recorded by ISAP 10,771 of these are recorded to a known county. Of these county provenanced axeheads, 7774 (35.66% of all axeheads) are recorded to a known townland and thus are well-referenced spatially. On occasion there may be multiple townlands of the same name in a particular county. These will normally occur in different administrative units: parishes and/or baronies. All axeheads provenanced to a townland in the ISAP database also have parishes and baronies recorded.

Many axeheads are not provenanced to a county but do have some degree of spatial referencing, for example, over 500 axeheads have been discovered in the vicinity of the River Bann (Woodman *et al.* 1999:78; Woodman *et al.* 2006:280–304). The ‘area’ field is a highly variable spatial referencing field for axeheads whose provenancing is problematic. Therefore, a reference in the ‘area’ field for an axehead could refer to a range of spatial scales of recording. The axehead could be known to have been discovered in a river valley or simply somewhere in Ireland.

ISAP are currently working towards assigning national grid co-ordinates to all axeheads from known townlands and more detailed provenances, such as archaeological excavations. This will be achieved by assigning the co-ordinates of the townland centroid or the site co-ordinates to the axehead record (townland centroids are derived from Ordnance Survey of Ireland and Ordnance Survey of Northern Ireland data).

A total of 3586 axeheads have known contextual information. For example, 685 were discovered on archaeological sites, 1167 were recovered from riverbeds, 293 from bogs and 25 from islands. The discovery circumstances, or activities that resulted in the axehead being discovered, are recorded for 2414 axeheads.

Morphological data:

Morphological characteristics are recorded for 18,754 axeheads. The remaining 2717 axeheads have not as yet been assigned a particular object type. The numbers for individual object types are illustrated in *Table 1*, with axes clearly being the dominant type.

The ISAP database allows for detailed recording of the morphological characteristics of axeheads. General morphological character-

Object type	Number	Percentage
Axe	13244	61.68%
Adze	927	4.31%
Axe/Adze	510	2.37%
Adze/Axe	371	1.72%
Wedge	12	0.05%
Chisel	210	0.97%
Roughout	3459	16.13%
Other	21	0.09%
Unknown	37	0.17%
Unrecorded	2680	12.40%

Table 1.
The number of axeheads assigned to different object types as a percentage of the total number in the database.

Face shape	Textual description	Number	Percentage
FS01	Ovate Symmetrical	607	2.82%
FS02	Assymetrical	5187	24.16%
FS03	Straight Splayed Sides	978	4.55%
FS04	Straight Parallel Sides	345	1.60%
FS05	Oblique Butt	937	4.36%
FS06	Any Other	4611	21.47%
N/A	Unrecorded	8806	41.01%

Table 2.
The number of axeheads assigned to different face shapes as a percentage of the total number in the database.

istics are assigned based on image templates for face shape, profile, cross section, blade profile, butt shape, edge form and edge shape. Each of these image templates is accompanied by a brief textual description. For example, an axehead would be assigned FS01 if its face shape were ovate and symmetrical. *Table 2* illustrates the numbers of axeheads assigned different face shapes. The dominant categories are FS02 (axeheads with one side convex in shape and the other straighter with an asymmetrical cutting edge) and FS06, axes that do not fit in the other five categories.

Primary and secondary treatment are both recorded in the ISAP database. For example 7474 axeheads have primary treatment recorded (*see Table 3*). Flaking can be seen to be the dominant primary treatment with pecking or hammering as the second most important category. Breaking this down by object type a very high percentage of roughouts have flaking as their primary treatment because the majority of the identified roughouts are of porcellanite and there are relatively few roughouts of other lithologies.

Primary treatment	Number	Percentage
Flaking	5930	27.61%
Pecking	1092	5.09%
Cleaving	91	0.42%
Unknown	361	1.68%
Unrecorded	13969	65.19%

Table 3.
The number of axeheads assigned to different primary treatments as a percentage of the total number in the database.

Petrographical data:

Petrographical data have been recorded for 18,844 axeheads in the ISAP database. These 18,844 axeheads have been assigned a macroscopic petrological identification (a surface identification). To test and calibrate the macroscopic identifications a programme of selective coring was undertaken. Hence 504 axeheads have been microscopically petrologically identified whilst geochemical trace element analysis data is recorded for 72 axeheads. The petrology of Irish stone axeheads has been discussed previously in detail and will not be elaborated upon here (e.g. Cooney & Mandal 1998; Cooney & Mandal 2000).

Photographs and Drawings:

Axehead analyses are complemented in some cases by the addition of photographs and drawings. There are 712 axehead records with photographs in the ISAP database (including all cored axeheads). These photographs contain within the image a scale bar and either the museum reference number or ISAP sequence number as an identifier. The photographs of each axehead normally record both faces, occasionally the profile and in some rare circumstances there are close-up images of notable features of the axehead. All axehead images are linked to their respective axehead analysis record in the database. Currently there are

drawings of over 2200 axeheads in the ISAP database. These drawings normally illustrate a face, the profile and cross section of the axehead.

The web portal (*Iaxe*)

Since late 2006, a programme of critical re-appraisal and correction of the ISAP database has been underway. This work has involved examination and where necessary correction of all the text and image data in the ISAP database. This programme has focused on standardising the data to as high a degree as possible to ensure the integrity and usability of the dataset. Parallel to this period of appraisal and correction a web portal for the database has been designed and constructed by Pippin Software Ltd. The ISAP web portal (*Iaxe*), to be made available online, will be accessible through the UCD School of Archaeology website (www.ucd.ie/archaeology – for queries contact stone.axehead@ucd.ie).

Iaxe allows complex queries to be constructed in a user-friendly format (Fig. 1). The user can search by any data field, from the county of provenance to the edge shape of the axehead. The user can also select a five-tiered sort order for the results of the query. If the user makes a mistake in their search and needs to

Fig. 1.
Iaxe query page.

The screenshot displays the 'Iaxe' query page, which is part of the UCD School of Archaeology Irish Stone Axe Project Database Search Page. The page features a header with the UCD logo and project name. Below the header, there is a section for 'Archival Data' and 'Physical Characteristics' search criteria. The 'Archival Data' section includes fields for Townland, Barony, Parish, Area, County, Context, Site Type, Discovery Circumstances, Museum Reference, and ISAP Database Reference. The 'Physical Characteristics' section includes fields for Object Type, Minature, Hafting, Object Status, If Incomplete, If Roughout, Primary Treatment, Secondary Treatment, Blades, Sides, Faces, and Butt. The page also includes a sidebar with links to 'ISAP Home Page', 'Reset Query', 'Set Sort Order', and 'Query Database'. A small illustration of an axehead is visible on the left side of the page.

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An Coláiste Ollscoile, Baile Átha Cliath

UCD School of Archaeology
Irish Stone Axe Project
Database Search Page

ISAP Home Page
Reset Query
Set Sort Order
Query Database

For the purpose of Searching the Irish Stone Axe database the search criteria have been grouped into three main sections. These are Archival, Physical Characteristics and Petrology. You can mix and match criteria from each section. To assist you with your search a notes page describes each of the search items. Click [here](#) to go to the notes page.

Archival Data

Townland
Barony
Parish
Area
County
Context
Site Type
Discovery Circumstances
Museum Reference
ISAP Database Reference

Physical Characteristics

Object Type
Minature
Hafting
Object Status
If Incomplete
If Roughout
Primary Treatment
Secondary Treatment
Blades
Sides
Faces
Butt

add in an extra search term, *Iaxe* stores the previous search terms which can be easily refined, allowing construction of detailed queries. It is not necessary to enter a full search term, for instance searching for the term 'porc' in the 'Macro ID' field will return all axehead records that have a porcellanite macroscopic identification. *Iaxe* produces a list of matches to any given search. This list shows a summary of the record for each axehead returned. By clicking on the desired record the user can then access the entire analytical record for the axehead.

Iaxe will operate a tiered access system for researchers. Researchers that acquire a username and password from ISAP will have access to an export facility. This facility will allow users to run queries as described above and then select the aspects of the data they need and export these to a tabbed document. This tabbed document can then be opened in other programmes such as MS Access to create mini-databases for use in research projects. *Iaxe* also allows ISAP researchers to remotely upload axehead analysis reports over the internet.

Fine grained sedimentary sources

The petrographical subdivision of Irish stone axeheads based on macroscopic examination (Fig. 2) shows that over 3700 stone axeheads in

Ireland have been identified as being made from fine-grained sedimentary rocks (Fig. 3). This figure represents about 20% of the total number of axeheads with macroscopic petrographical identification. After porcellanite these lithological sources are the most important used to make stone axeheads in Ireland. However, they differ very significantly from porcellanite in that they do not form a petrologically distinct group originating from a small number of geologically distinctive sources but rather are a broad petrographical and morphological grouping. Fine grained sedimentary axeheads are of particular archaeological interest as they have been recorded from sites dating to the early Mesolithic, such as Mount Sandel, Co. Derry (Woodman 1985) and Hermitage, Co. Limerick (Collins & Coyne 2003, 2006), the later Mesolithic, as at Ferriter's Cove, Co. Kerry (Woodman *et al.* 1999), through the Neolithic, for example at Knockadoon, Lough Gur, Co. Limerick (Ó Ríordáin 1954; Grogan & Eogan 1987) and well into the Bronze Age, as at Clonfinlough, Co. Offaly and Cahercommaun, Co. Clare (Moloney *et al.* 1993; Cooney & Mandal 1999).

A wide range of geological terms has been employed in previous studies to describe the fine grained sedimentary rock types that were used to make stone axeheads. At a macroscopic level, it can be difficult to accurately classify

Fig. 2.
The petrographical
subdivision of
Irish stone axeheads.

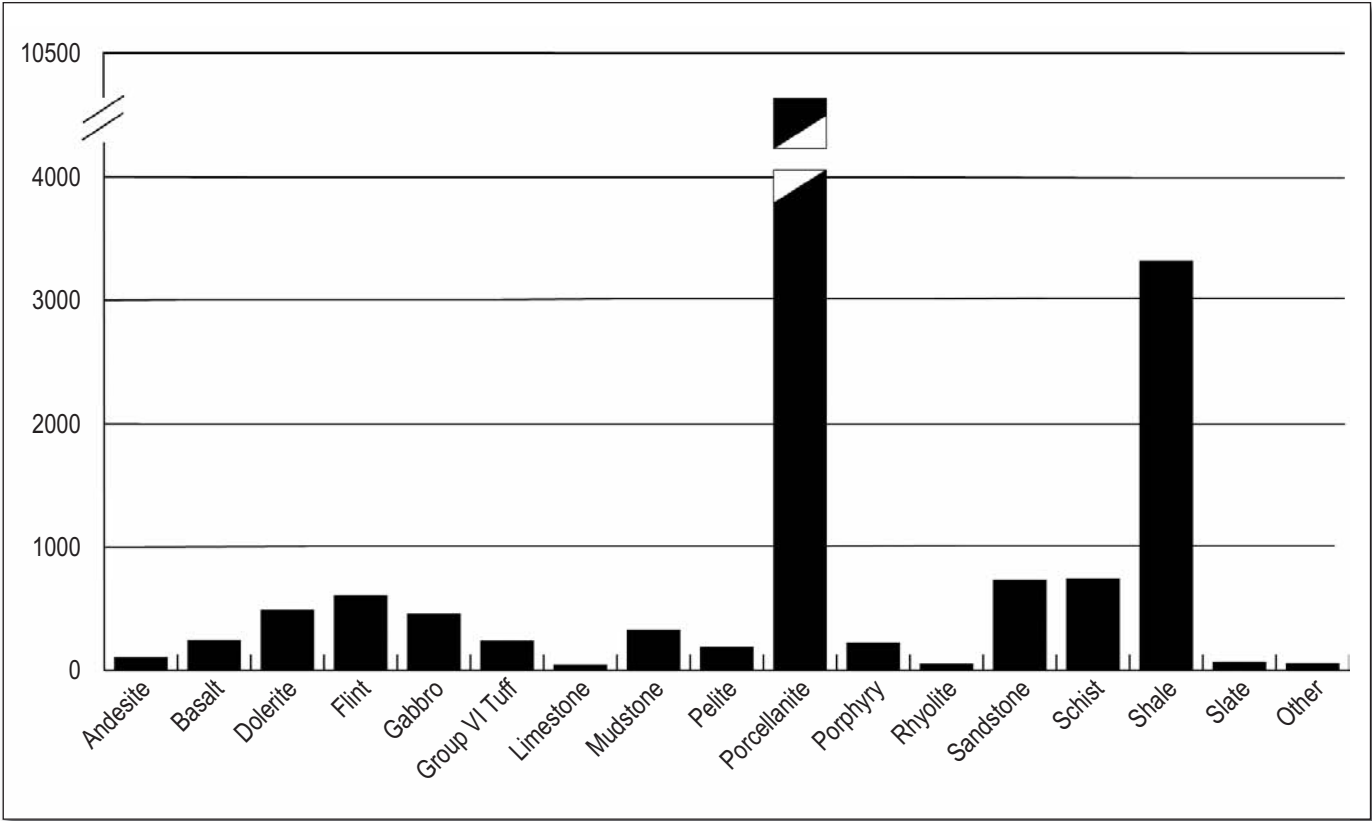


Fig. 3.

A shale axe (NMI 1933:1261; ISAP:2001) from Ballyportry South, near Corofin, Co. Clare. Discovered in the early 20th century during turf cutting near the shores of Monana Lake.



such rocks. This is because from a geological perspective these rocks are mainly classified based on textural, gradational scales. For example, looking at clastic sediments, rocks of identical composition can be classified as sandstone, siltstone or claystone, depending solely on the clast size. Added to this, to date there has been no large-scale examination of fine grained sedimentary axeheads from a wide variety of find-spots and contexts in Ireland and limited cross-referencing of results between studies previously undertaken. A further problem is that there has been a tendency, including by ISAP, to use general terms, such as mudstone, for ease of discussion. For example, Woodman and Johnston (1991/2:135) recognised the textural and petrographic variability within a sample of axeheads from the later Mesolithic Newferry site (Woodman 1977) but for the purposes of discussion they were all described as mudstones. In a similar way Mandal *et al.* (1991/2) used the term 'pelite' to cover fine grained, dark coloured sediments while recognising that this term covered a variety of rock types.

In approaching these issues, it was clear that a more consistent and coherent set of terms was needed for the description of fine grained sedimentary rocks, in particular macroscopically. After the initial programme of macroscopic identification presented in Cooney & Mandal (1998), a re-evaluation of the identifications of the fine grained sedimentary axeheads was carried out. In addition, the issue of the petrography of these axeheads was addressed by coring 68 of them (a 2% sample of the total number) for polished thin-section and x-ray diffraction analysis. A detailed examination of a sample of 600 axeheads (a 16% sample of the total) was carried out, focusing on the methods of manufacture, morphology and typology, distribution and context of discovery. In approaching broader questions, such as potential sources, the results from this detailed examina-

tion are placed in the context of the overall patterns of distribution of fine grained sedimentary axeheads.

The fine grained sediments that have been recognised as sources for stone axeheads in Ireland include argillaceous limestone, mudstone, nodular weathered sediment, pelite and shale. The most striking result of this programme of work is that shale accounts for over 85% of the total of axeheads made from fine grained sediments. Shale is distinguished by the presence of a well-marked bedding plane fissility (parallel lamination). In the case of stone axeheads the parallel lamination is most usually parallel to the thickness and perpendicular to the width and length of the axehead. The importance of shale as a source is significantly greater than indicated in Cooney & Mandal (1998). Correspondingly the number of axeheads that can be classified using the more general term of mudstones has been reduced (compare Fig. 2 with Cooney & Mandal 1998:table 4.1). The thin-section analysis confirmed that shale is by far the most commonly used fine grained sedimentary rock source to make stone axeheads. The shale axeheads fall in a number of petrographical groups and sub-groups characterised by texture and the presence or absence of minerals. The largest and most closely defined group are fine grained parallel bedded chloritised shales, characterised by the presence of fine framboidal wisps of pyrite, forming thin bands, 2–7mm apart. The XRD study illustrated that the majority of the fine grained sedimentary axeheads examined, both of shale and mudstone, contain the same range of minerals. As with the thin-section analysis, it is possible to group the axeheads based on the presence or absence of minor minerals.

The identification of sources for fine grained sedimentary axeheads is clearly a different problem. Firstly, there are numerous and widespread outcrop sources for these rock types in Ireland. Secondly, and of equal importance, it would appear that the majority of such axeheads have been manufactured from water rolled cobbles. These and other issues are considered in more detail in Cooney & Mandal (forthcoming) but one key question that is appropriate to comment on is the question of the dating of fine grained sedimentary axes. Woodman's consideration of fine grained sedimentary axes in Ireland in a number of publications (e.g. Woodman 1977, 1978; Woodman & Johnston 1991/2; Woodman *et al.* 1999; Woodman *et al.* 2006) has been an important contribution to the interpretation and dating of these objects. Based on the occurrence of fine



grained sedimentary axeheads in the Mesolithic, particularly in later Mesolithic contexts, Woodman argues that the large number of axeheads from the Shannon at Killaloe, on the shores of Lough Gara and the Bann valley are likely to be Mesolithic in date (e.g. Woodman *et al.* 1999:80; Woodman *et al.* 2006:300). Woodman quite rightly has queried the assumption that any polished stone axehead dates to the Neolithic, unless it can be proven otherwise. However, it may be equally problematic to assume that because the use of fine grained sedimentary axeheads was a feature of the Mesolithic in Ireland, that all the large number of such axeheads in river valley locations necessarily date to the same period. As mentioned above, there are significant numbers of fine grained sedimentary axeheads in a range of Neolithic contexts, clearly demonstrating the continued use of these sources in this later period. This continuity in use of lithic sources as an aspect of the transition from the Mesolithic to the Neolithic in Ireland may be relevant to understanding the processes involved in that transition. It certainly suggests that the organised production of axeheads from particular primary sources during the Neolithic (see below) was contemporary with and complementary to the much more expedient use of widely available secondary sources, in this case fine grained sedimentary sources.

This wide use of secondary sources has been a point consistently made by Briggs (e.g. 1988). He has further suggested in reviewing the work of ISAP (Briggs 2001) that much greater attention needs to be paid to the variety of lithic resources available in Irish glacial deposits, including the occurrence of sources, such as porcellanite, which are known to have been quarried at outcrop or primary source(s), if we are to obtain an accurate balance of the use of different sources.

The porphyry quarry on Lambay

Bearing this wider question of the use of both primary and secondary sources in mind, one of the principal aims of ISAP is the identification of previously unrecognised quarry sites in Ireland where stone axeheads were produced. In the 1920s a number of stone axeheads were discovered during work at the harbour on the island of Lambay off the east coast of Ireland (Macalister 1929; Rynne 1976; Herity 1982) and it was thought that these were made from a distinctive source on the island, porphyry or porphyritic andesite. Macroscopic identification by



Fig. 4.
Eagle's Nest
porphyritic andesite
quarry face
(eastern valley)
and working floor
with debitage.

ISAP (Fig. 2) indicates that there are well over 200 axeheads made from porphyritic andesite and geographically these are concentrated in eastern Ireland, hence an assessment of the porphyry on the island was carried out.

The porphyry on Lambay occurs in sheet form, intruded into lava and other volcanic deposits. The porphyry is a distinctive grey-green (more unusually purple) basaltic andesite with pale green phenocrysts of plagioclase up to 2cm long, usually altered to calcite and white mica. The outcrops have a consistent petrography and geochemistry and it seems probable that they were emplaced in a phase late in the volcanic history of the island (Stillman 1994; Mandal 1996a). The outcrops occur across the island but particularly in the central area. Here at a location known as the Eagle's Nest, outcrops of porphyry form two small valleys orientated northwest to southeast. To the south and the north the ground drops away (steeply to the north). There is a general rise in ground level to the east and the western edge of the area is formed by the top of a vertical cliff-face. Excavation has demonstrated that the porphyry outcrops at the Eagle's Nest were quarried during the Neolithic and the quarried rock was used for axehead production (Cooney 2005, 2009a, 2009b).

The porphyry had been quarried (Fig. 4) to provide suitable blocks that through the primary treatment of hammering and pecking (with some flaking) could be roughed out as





Fig. 5.
Sandstone rubber
from the Eagle's Nest
quarry site.

axeheads and were then ground and polished to a finished form. A number of distinctive, recurring shapes can be recognised in the debitage and these suggest that a distinctive *chaîne opératoire* was employed, despite the difficulty of controlling production when pecking and hammering were the main working techniques used. All stages of axehead production took place on the site and tools associated with different stages were present; large cobbles of conglomerate and granite to break blocks off the outcrop; granite, quartzite and other lithologies used as hammerstones in roughing out the axes and sandstone grinding slabs of different degrees of coarseness that were used in grinding and polishing the axeheads (Fig. 5). This porphyry quarry is the first definite example in Ireland or Britain where the rock was worked primarily by hammering and pecking, rather than flaking. It indicates that these processes do leave traces in the archaeological record (pace Coope 1979; Mercer 1986). Secondly it forms a notable exception to what is taken to be the standard pattern where the later stages of the production process take place at distance away from the source (e.g. Bradley & Edmonds 1993:40) Hence the Eagle's Nest provides a new perspective on the organised quarrying and production of stone axeheads during the Neolithic period in Ireland and Britain, a point that is further emphasised when the dating of the episodes of quarrying and the range and sequence of deposition of material at the site is considered.

There is a series of radiocarbon dates from the Eagle's Nest, including nine which are measurements of single-entity short-life charcoal samples (Cooney *et al.* forthcoming a). Four samples were submitted from debitage layers with early Neolithic carinated bowl pottery in one of the excavated quarry areas

(Cutting 11). Two of these (SUERC-4130, -42132) produced dates in the eighth and seventh millennia BC and must have been redeposited. The other two samples were dated to 3790–3640 cal BC (95% probability, SUERC-4129) and 3940–3660 cal BC (95% probability, SUERC-4131) and are in good agreement with the stratigraphic sequence and cultural context. These dates suggest a period of quarrying in the 38th or 37th centuries cal BC. They are also statistically consistent with four of the dates from depositional contexts on the floor of the eastern of the two valleys. On the other hand a date from a linear cut feature here; 3350–3010 cal BC (95% probability, SUERC-4138) indicates activity in the later part of the fourth millennium cal BC, consistent with the occurrence of middle Neolithic pottery and other material.

The question of the date and character of the evidence from the site is related to the question of why people came to the Eagle's Nest to quarry porphyry. On functional grounds, the use of this source would seem counter-intuitive as it fractures very easily, which is part of the reason for the very large build up of waste on the site; success would have been unpredictable (Cooney 2005:23). On the other hand, it has a striking appearance when polished, a feature that attracted attention from early in the Neolithic. This process emphasises the distinctive contrast between the feldspar crystals and the green background (Cooney 2002; Fig. 6). In this context it is interesting that there is clear

Fig. 6.
The cultural
transformation of
porphyry through
axe production.





Fig. 7.

A setting of stone
focused on a large slab,
main area (eastern valley),
Eagle's Nest site.

evidence from the excavation that the original outcrop surfaces were glacially striated, in other words they would have appeared to have been polished. Is it possible that working porphyry was about transforming and giving a cultural sheen or polish to this powerful, unusual stone? At the Eagle's Nest there is certainly strong evidence that suggests that quarrying was seen as a special activity on an island where there is evidence of a long-term, persistent human presence in earlier prehistory (Dolan & Cooney 2010). On the floor of the eastern valley there is a sequence of features that begins early in the Neolithic with pits, some of which are deliberately cut into by later pits. Then there is a switch to the placing of stone, dominated by porphyry waste and other material on the ground, over the pits, forming distinct features (Fig. 7). Some of these later features are reminiscent of the settings found outside passage tombs (Eogan 1986; Cooney 2005), suggesting that this activity took place in the later part of the fourth millennium BC. A range of objects were placed during these episodes of deposition, including a couple of hoards of large numbers of flint flakes and one that included a pestle macehead (made from a non-local source), a porphyry roughout and polished porphyry axehead. A notable feature was the deposition of jasper, a red, silica-rich stone that outcrops as veins on the island and can also be found as pebbles on the beaches. As well as broken and tested pebbles there were a small number of jasper beads and pendants. It would seem that the jasper was being worked either on the site or elsewhere on the island. Deposits of beach gravel are another indicator of the deliberate placement of material brought up from the coast of the island. Ultimately this build-up of material resulted in the creation of a low monument, a

cairn about 10m across. Porphyry was worked and deposited and other material was brought to this special place and deposited. These actions would have created connections between people and the materials that were being worked and used. The placement of material on or under the ground may be seen as complementing the quarrying of the rock, giving material back to the earth and making linkages to the realm of the supernatural. The material itself demonstrates links between the island and the wider world (Cooney 2004c, 2009b). In the deposition of porphyry roughouts and axeheads we see the beginning and end of the 'life' of objects being deliberately brought together, the significance of this special activity eventually marked by the construction of a low monument.

Axes in the early Neolithic

So what is the wider context of the quarrying of porphyry on Lambay from early in the Neolithic? As has been pointed out above a distinctive feature of the Irish Mesolithic is that ground stone axeheads formed part of the tool kit, in distinction to Britain but a feature shared with Scandinavia (e.g. Bergsvik 2006; Blankholm 2008). What had seemed a clear distinction between the use of only secondary sources in the Mesolithic and the beginnings of quarrying in the Neolithic (Cooney 2004b) needs reassessment in the light of Kador's work on the products from the Monvoy, Co Waterford rhyolite quarry (Kador 2009; see also Green & Zevebil 1990:68–70) and the discovery of what appears to be a later Mesolithic festooned chert quarry at Knockeyon, Lough Derravaragh, County Westmeath (O'Sullivan *et al.* 2007; Little 2009). However, significant changes do occur after 4000 BC, the range of lithologies utilised increases, organised axe production takes place at specific sources (as at the Eagle's Nest) and products from some of these sources have been found on Early Neolithic sites (Cooney 2007, 2008).

For example a porcellanite axehead from the quarries at either Tievebulliagh or Rathlin Island, Co. Antrim in northeast Ireland (Cooney 2000:202–4) was found as a formal deposit in a ditch segment at the causewayed enclosure at Magheraboy, Co. Sligo (Fig. 8), over 180km to the southwest, where activity started in 4115–3850 cal BC (Danaher 2007:13; Bayliss *et al.* 2007; Mandal 2007). The axehead is dated by sapwood from a burnt oak plank at the base of the ditch to 3965–3810 cal BC (95% probability,





Fig. 8.
Axeheads from the ditch
of the Magheraboy,
Co. Sligo causewayed
enclosure. Mudstone
axehead found with
fragments of quartz
crystals on left,
deliberately broken
porcellanite axehead
on the right.
Photo: J. Hession

GrA-31961). This suggests that porcellanite may have been in circulation across the northern part of Ireland by the 40th or 39th centuries cal BC although the dates for the Magheraboy enclosure currently significantly pre-date dates for a broader spectrum of early Neolithic activity (Cooney *et al.* forthcoming a). There are significant quantities of porcellanite at some of the early rectangular buildings in Ireland dating to 3750–3600 BC (Cooney *et al.* forthcoming b), as at Ballyharry, Co. Antrim (Moore 2003, 2004) and Thornhill, Co. Londonderry (Logue 2003). Whatever the status of the very early date from Magheraboy, this evidence clearly indicates that the exploitation of one or both of the known porcellanite sources began early in the Neolithic. Sheridan (2007a, 2007b:264) has argued that one important contemporary development was the presence of jadeitite axeheads in the early Neolithic, as in the case of the example deposited beside the Sweet Track in the Somerset Levels in southwest Britain sometime around 3807/3806 cal BC (Coles & Bruning 2009). Coming from two principal Alpine sources (e.g. Pétrequin *et al.* 2006, 2008a, 2009) the jadeitite axeheads in Britain and Ireland appear to have been made several centuries before their deposition (Pétrequin *et al.*

2008b). It has been argued that some of these forms were copied in axeheads made from Irish and British lithological sources (Pailler pers. comm.; Sheridan 2007a).

It would appear then that these objects may have played an important role in demonstrating and materialising new ways of thinking about and working with the world. It is striking that many of the sources that were quarried to make stone axeheads in the early Neolithic were made from visually distinctive sources, often from special places (Cooney 1998, 2002). Is it possible that we are seeing in the use of these sources, and the distribution of axeheads made from them, the active ways in which this highly symbolic object was actually both emblematic of new ways of life bound up in farming and part and parcel of how it came about? Ray (2004:171) suggests it may also be useful to think of such sources as nodes in a pattern of exchange involving stone and other objects in a network of social relations that extended over land and sea. The contrast between axeheads made from non-local sources with those from locally available stone would have been present from very early in the Neolithic (Cooney 2000: 197–205). These objects may have been of particular importance in the development, main-



tenance and re-ordering of relationships between communities. The key point is that quarrying and procurement of axeheads (and other objects) may have been critical from the start in defining what it was to be 'Neolithic', and not something that developed during that period (Cooney 2008:208–9).

Prospects

So where does the project go from here? One immediate focus will be to make the ISAP web portal (*Iaxe*) operational. This will allow researchers access to the results of the project and will also demonstrate the approach that the project has taken. An immediate objective in terms of data acquisition when the portal has gone live will be to acquire and add all the details of the significant quantity of axeheads that have come from the large number of development-led excavations carried out in Ireland over the period from the mid-1990s to 2008. Through providing reports on such finds for excavation reports ISAP has accumulated a lot of this data but not on a systematic basis. On some sites a significant number of stone axeheads have been recovered as part of lithic assemblages. Perhaps most notable in this regard has been the material from the enclosure and settlement at Tullahedy, Co. Tipperary, excavated due to road development (McConway 1999; Kelleher 2009). This has revealed a large number of axes. Analysis of polished thin sections (H. Kelleher & R.V. Davis, pers. comm.) has identified the presence of a number of volcanoclastic petrologies which are distinctively different from those characteristic of Group VI axeheads from Cumbria, northwest England. This raises again the important question of whether similar lithologies were exploited in Ireland and are the source(s) for the Tulladehy and other volcanoclastic axeheads that cannot be seen to fall within the petrographical range of Group VI (see discussion in Cooney & Mandal 1998:118–9).

The project has also been working on the nature of the utilisation of the porcellanite source at Brockley in the context of its island setting. It is becoming clear that the quarry has to be seen in and as part of its insular setting. Production was widespread across the island and while the final stages of axehead production may not have taken place at Brockley itself, grinding and polishing of axeheads took place relatively close to the site (Cooney *et al.* forthcoming b). Recognition of the early date for the beginnings of porcellanite production in the

Neolithic, the sheer quantity of porcellanite axeheads, advances in integrated approaches to sourcing and distributional studies (e.g. Bevins *et al.* in press) allied to the data on the ISAP database make it an appropriate time to engage with the key question of the character and wider role of porcellanite as a source, including definitively discriminating the two sources and their relative importance.

Work is ongoing on the second ISAP monograph (Cooney & Mandal forthcoming). This will feature an extended discussion of fine grained sedimentary axeheads, will look at the axeheads from the river Shannon as a geographical and contextual study and analyse the deposition of stone axeheads in hoards in Ireland. Work is also ongoing on the post-excavation analysis of the quarry site at the Eagle's Nest. There is a lot of work to look forward to!



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■ ■ ■ *"...the supreme object of desire is a polished jade axe...I'm holding it very carefully, because it still looks absolutely brand new and very sharp. It's the shape of an oversized tear drop, about seven inches long and at the base about two or three inches wide. It's cool to the touch and extraordinarily, pleasingly, smooth".*

At 9.45am on February 4th 2010, the BBC broadcast a fifteen minute programme devoted to a Jadeitite axe recovered from the margins of the River Stour, near Canterbury. Part of the BBC/British Museum radio series *"A History of the World in 100 Objects"*, the programme traced the biography of the blade from its origins in the Italian Alps, using it as a touchstone for a discussion of the Neolithic, the origins of farming and the social geographies of Western Europe in the 5th and 4th millennia BC.

For the millions who listened or downloaded the podcasts, the axe stood for the tools that *"enabled our ancestors to create a green and pleasant land..."* and for the ties that bound those *"on the edge of the world..."* to communities on the continent. Myths of origin and entanglement, both traced in stone. We have come full circle. ■

Photo: © Trustees of the British Museum

●●● *It was a kind of excavation. I opened the box that A had placed in front of me and removed the parcels one by one, some wrapped in paper, others in bark tied with a cord of woven grass or hair. One was heavier than the rest. It had a kind of density that made me pause in the unpacking. I rolled back the wrapping and a small black axe slid into my palm. The blade, like the bark, was from southern Australia, the wrapping typical of the wallets in which ceremonial items were often bound between exchanges. "How did you come by this; what's it doing in Cheshire" I asked. "Well" said A, "it's rather a long story..." ●*